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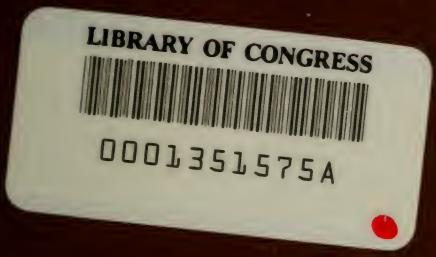

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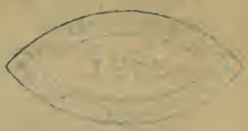
MAGIC,

PRETENDED MIRACLES,

AND

REMARKABLE

NATURAL PHENOMENA.



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☞ The present volume is issued under the above arrangement.

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MAGIC, PRETENDED MIRACLES,

ETC

CHAPTER I.

The magi of the east—Magical power attributed to numbers, plants, and minerals.

The magi formed one of the six tribes into which the nation of the Medes was divided in ancient times. To them was entrusted the special charge of religion; and, as priests, they were superior in education and training to the people in general. Among the Persians, "the lovers of wisdom and the servants of God" were, according to Suidas, called magi. It seems also, that they extended themselves into other lands, and that among the Chaldeans they were an organized body.

We read in the inspired book of Daniel, of "the magi," or "wise men," among whom the prophet himself was classed; and others, we know, directed by "the star in the east," went to the infant Saviour, when born, at Bethlehem, "as Christ the Lord," and presented to him their offerings, "gold, and frankincense, and myrrh." Among the Greeks and Romans, the

same class of persons was styled Chaldeans and magi.

For a time, the magi surpassed the rest of the world in knowledge, and were the friends, companions, and counsellors, of its mightiest sovereigns. But their science, from having no solid basis, sank, after a while, into insignificance. On the ruins of its reputation other persons sought to build theirs. A man who knew, or could perform some things, with which others had no acquaintance, or for which they had no power, announced himself as a magician. Nor were the people indisposed to concede to him the credit he desired, especially if he claimed alliance with spiritual beings; and, in not a few instances, they attributed his marvels to such agency. Thus, then, the magician may be traced to the *magus*, or magian; and magic, to the so-called philosophy of the east

Magic squares are of great antiquity. A square of this kind is divided into several other small equal squares, or cells, filled up with the terms of any progression of numbers, but generally an arithmetical one; so that those in each band, whether horizontal, vertical, or diagonal, shall always make the same sum. The ancients ascribed to them great virtues; and the disposition of numbers formed the basis and principle of many of their talismans. Accordingly, a square of one cell, filled up with unity, was the symbol of the Deity, on account of the unity and immutability of God;

for they remarked that this square was, by its nature, unique and immutable; the product of unity by itself being always unity. The square of the root two, was the symbol of imperfect matter, both on account of the four elements, and of its being supposed impossible to arrange this square magically. A square of nine cells was assigned or consecrated to Saturn; that of sixteen to Jupiter; that of twenty-five to Mars; that of thirty-six to the sun; that of forty-nine to Venus; that of sixty-four to Mercury; and that of eighty-one, or nine on each side, to the moon. Those who can find any relation between two planets, and such an arrangement of numbers, must have minds strongly tinctured with superstition; yet so it was in the mysterious philosophy of Iamblichus, Porphyry, and their disciples.

Plants, as well as numbers, were long considered to be endowed with magical properties. Pliny enumerates those which, according to Pythagoras, were supposed to have the power of concealing waters. To others were attributed extraordinary effects. The *asyrites*, as it was denominated by the Egyptians, was used under the idea that it acted as a defence against witchcraft; and the *nepenthes*, which Helen presented, in a potion, to Menelaus, was believed, by the same people, to be powerful in banishing sadness, and in restoring the mind to its accustomed, or even to greater cheerfulness. Whatever may be the virtues of such herbs, they were used rather from an

idea of their magical than of their medicinal qualities; every cure was cunningly ascribed to some mysterious and occult power.

From the same superstition, metals and stones were supposed to be endowed with singular virtues: the opal, to grow pale at the touch of poison; the emerald, to remove intoxication; and the carbuncle, "only to be found in the head of the dragon, the hideous inhabitant of the island of Ceylon," to shine in the darkness. As the metal called gold always bore the highest value, it was concluded, from an absurd analogy, that its power to preserve health and cure disease must likewise surpass that of all other applications. Multitudes gave themselves to busy idleness in attempting to render it potable, and to prevent it from again being converted into metal. Not only did they labour in obscure situations, but in the splendid laboratories of nobles and sovereigns. Men of rank, impelled by one common frenzy, formed secret alliances; and even proceeded to such extravagance as to bring ruinous debts on themselves and their posterity. The object of which they were in pursuit was "an elixir of life."

In Italy, Germany, France, and other countries, the common people often denied themselves the necessaries of life, to save as much as would purchase a few drops of the tincture of gold, which was superstitiously or fraudulently offered for sale. So fully did they confide in the efficacy of this imaginary power,

that on it generally depended their only hope of recovery. Positively was the desired boon promised, but only to mock expectation. Our times are in the hands of God; and at his will the dust returns to the dust from whence it was taken, and the spirit to him who gave it.

How fearful was the ignorance that prevailed in the bygone times to which a reference has been made! What gratitude should we feel for the advantages we enjoy! Let us, then, constantly remember that as to us much has been given, so of us much will be required; and that one kind of knowledge surpasses all others: "This," said the adorable Redeemer, "is life eternal, that they might know thee the only true God, and Jesus Christ, whom thou hast sent," John xvii. 3.

CHAPTER II.

Feats of modern magicians—Their wonders explained—The snake-charmers of India—A Chinese delusion—The magician of Cairo.

WONDER-WORKERS have often appeared. Some of them have lately repeated their most remarkable feats in London and various places in England, varied by others of inferior interest. Large and astonished assemblies have witnessed their performance, and public journals have described them as absolutely "inexplicable." And yet, though the writer has no personal acquaintance with any modern "magician," he has no doubt that all their feats may be accounted for, from sleight-of-hand, confederacy, ingenious contrivance, or the application of some natural law. A few illustrations shall now be given.

Many delusions are entirely dependent on *sleight-of-hand;* a rapidity of manipulation being attained by long practice, as in the marvellous movements of the fingers of a highly accomplished instrumental performer; while the power may become so great as to defy the

observation of the acutest vision. The late Mr. Walker, minister at Demattar, in the Mears, told sir Walter Scott of a young country girl, who threw turf, stones, and other missiles, with such dexterity, that it was, for a time, impossible to ascertain the agency employed in the disturbances of which she was the sole cause.

A friend of the writer has a remarkable nicety of touch, and, at pleasure, a rapid movement of the hands, by which he can rival many magical feats. Thus he conveys balls under cups, and appears to change them into fruit, to the astonishment of lookers-on. He also takes two horn cups of exactly the same size, and produces the impression that he causes one to fall through the other, when this is impossible, and all that is done is effected by dexterous and rapid manipulation, illustrating the proverb, "The hand is quicker than the eye."

Many astounding feats, which form a part of all popular magical exhibitions, are performed by this leger-de-main. Apparently, the performer receives a lady's wedding-ring and breaks it in pieces; burns a five-pound note handed to him by a spectator; reduces a hat to a hideous shape; or crushes a bonnet into fragments, and then restores them uninjured to the respective parties, amidst the acclamations of the multitude. But all that is done is with indescribable rapidity to substitute articles of his own to undergo the process of destruction, and, at the right moment, to exhibit those

which have been presented by the spectators, and are preserved in safety.

Another cause of wonderment is *confederacy*. A modern performer has been accustomed to hand a box to one of his audience, requesting that in it might be placed any article that he had, and that it might be passed on from one to another for the same purpose. While this has been done, he has proceeded to his table, and apparently waited the filling of the box. At length, while the box has been held up at a distance, he has placed his rod to his eye and described the collection that has been made. He has said, perhaps, "I can see in that box a piece of ribbon, a lozenge, a few grains, part, I dare say, of a pinch of snuff, and a lady's card; I will try and read it—Miss — Clara — Henderson;" and so he passes through the chief part of the series. And yet, as his patrons look on with astonishment, they do not think of what is most likely to be the fact, that a confederate, sitting as one of the audience, made a list of the articles as they were deposited in the box, and despatched it in portions or altogether, so that their names might reach the eye of the performer from some part of his table.

A third means of wonder-working is that of *ingenious contrivance*. We will illustrate this by two popular feats. A number of handkerchiefs taken from the audience by more than one popular performer, were placed in a small washing-tub, into which water was poured, and they were washed for a few minutes. They

were then placed in a vessel like the figure, below, and immediately afterwards the performer said to the persons in front: "I will give you these;" and taking off the top, when he was expected to throw out the wet handkerchiefs, all that fell was a number of flowers. He now brought out a box, which he opened, and showed it to be empty; then shutting it, and uttering a few cabalistic words, he opened it again, and there were the handkerchiefs, all dry, folded, and scented, which he distributed to their respective claimants.

Another experiment of a popular performer was called "coffee for the million." Producing a vessel like the diagram A; the performer filled it with unground coffee, and placing it under a cover B, he said, "There, when you have done that, let it simmer for three-quarters-of-an hour; but, perhaps, you will not like to wait so long; here

A

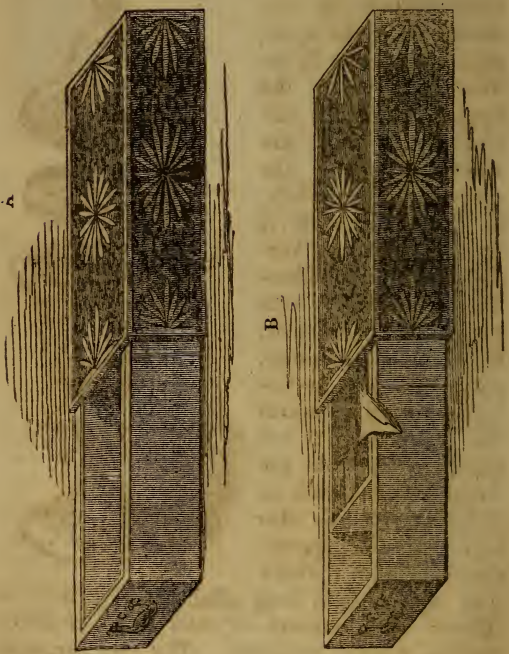
B

then it is;" and on removing the cover, the vessel appeared full of hot liquid coffee. In another vessel of the same kind he obtained lump-sugar from rape-seed; and in a third, warm milk from horse-beans; and pouring out the coffee into cups, sent them round to regale his auditory, amidst their loud and approving shouts at so great a transformation.

As these feats are the result of considerable ingenuity, it is probable that the devices employed would not readily occur to spectators in general, while they would utterly escape those whose object is merely amusement, and who, if they thought at all, would be likely to describe the result as supernatural. We proceed, then, to the unravelling of the mystery. Let it be observed, in reference to the first experiment, that a number of handkerchiefs are collected in the early part of the evening for various illusions, and that many of them appear for a time on the performer's table. Provided with a collection of these articles, from the handsome silk handkerchief to one trimmed with lace, used by a fashionable lady, he could easily substitute his own of the same kind for those of his auditory, as the curtain falls, according to the arrangements of the evening, between the collection of the handkerchiefs and the subsequent process. His own handkerchiefs, there-

fore, are washed and placed in the vase already described; and the so-called change into flowers is nothing more than the retention of the handkerchiefs in the lower part of the apparatus, which the figure illustrates, while the upper part holds the flowers till they are scattered among the spectators. Meanwhile, all that is required is done to their handkerchiefs. It is not absolutely necessary that they should be washed; for folding, pressing, and a little eau-de-Cologne, would complete the preparation; but granting that they are washed, there is still no difficulty, though this mystifies the spectators, who have the idea that drying is a long affair; for it may be effected in a minute or two by a machine that is readily obtained. The box brought out has them deposited in it, but as it is double, one interior is first shown, which, of course, contains nothing, for the inner drawer holding the handkerchiefs remains in the case;

but when a few sounds are uttered and the professor touches a secret spring behind, which disengages the inner box, he draws it out with the outer one; and presents the handkerchiefs



to the audience. In the diagram A, the box is shown as empty. At B, we have a representation of the box containing the handkerchiefs.

It is only necessary to add that the box is very nicely made; the part within the other drawn out to the end, defies detection.

The preparation of coffee, milk, and sugar, may be easily explained; for if the vessels containing respectively the unground coffee, the rape-seed, and the horse-beans, always placed under a cover, be put on a part of the table

having a circular trap-door—and for this there is full provision in the cover of the table ex-

tending to the floor—a confederate may readily substitute one for the other.

The Rev. W. Arthur, in his work on the Mysore, directs us to results of a different kind: —"Whilst walking in the verandah," he says, "some snake-charmers approached, and forthwith began to show us their skill. They produced several bags and baskets, containing serpents of the most poisonous kind—the cobra di capello; then blew upon an instrument shaped like a cocoa-nut, with a short tube inserted, and producing music closely allied to that of the bag-pipe. The animals were brought forth, raised themselves to the music, spread out their head, showing the spectacle mask fully distended, and waved about with considerable grace, and little appearance of venom. The men coquetted with them, and coiled them about their persons, without any sign of either dislike or fear. This power of dealing with creatures so deadly is ascribed by the natives to magic. Europeans generally account for it by saying that the fangs are extracted. But the most reasonable explanation seems to be, that when the snake is first caught, by a dexterous movement of the charmer, the hand is slipped along the body, until it reaches the neck, which he presses so firmly, as to compel an ejection of the virus; thus destroying, for a time, all power to harm; and that this operation is repeated as often as is necessary, to prevent the dangerous accumulation. If this be true—and I believe it is—nothing is neces-

sary to the safe handling of these reptiles, but a knowledge of the laws which regulate the venomous secretion. The wonder seems to lie in the power they possess of attracting the snakes by their rude music, and seizing them in the first instance. But enough is known to make it evident that, in what all natives and many Europeans regard as mysterious and magical, there is nothing but experience, tact, and courage."

A strange and repulsive feat is thus described by the Rev. G. Smith, in his recent work on "China." "Aquei conducted us into a room, where he was sitting with his two wives, handsomely attired, looking from a window on the crowd assembled in the street to witness the performances of a native juggler. The latter, after haranguing the crowd with much animation in the Nanking dialect, (as is usual with actors,) proceeded to one part of the crowd, and took thence a child, apparently five or six years old, who, with struggling resistance, was led into the centre of the circle. The man then, with impassioned gesture, violently threw the child on a wooden stool, and, placing him on his back, flourished over him a large knife; the child all the time sobbing and crying as if from fright. Two or three older men from the crowd approached, with earnest remonstrances against the threatened deed of violence. For a time, he desisted, but, soon after, returning to the child, who was still uttering most pitiable cries, he placed him with his back upwards,

and, notwithstanding the violent protests of the seniors, he suddenly dashed the knife into the back of the child's neck, which it appeared to enter till it had almost divided it from the head; the blood meanwhile flowing copiously from the wound, and streaming to the ground, and over the hands of the man. The struggle of the child grew more and more feeble, and at last altogether ceased. The man then arose, leaving the knife firmly fixed in the child's neck. Copper cash was then thrown liberally into the ring, for the benefit of the principal actors. These were collected by assistants, all of them viewing the influx of the coins with great delight, and bowing continually to the spectators, and reiterating the words, 'To seoz,' 'Many thanks.' After a time, the man proceeded towards the corpse, pronounced a few words, took away the knife, and called aloud to the child. Soon there appeared the signs of returning animation. The stiffness of death gradually relaxed, and at last he stood up among the eager crowd, who closed around him, and bountifully rewarded him with cash. The performance was evidently one which excited delight in the bystanders, who, by their continued shouts, showed their approbation of the acting."

It is almost superfluous to add, that the deception consisted in the construction of the blade and the handle of the knife, so that, by making a sawing motion on the throat of the child, a stream of coloured liquid, resembling

blood, is pumped out; a little acting on the part of the performer and the child is amply sufficient for all the rest.

Within the last few years, we have had accounts of a magician in Egypt, first described in a valuable work on that country by Mr. Lane, which produced an extraordinary impression. The magician, it was said, caused a boy to see certain persons called for, in a little ink, placed in his hand, in the centre of a double magic square, somewhat like the figure. One of the most profound writers of the age even wrote: "There will be no lack of confidence to pronounce; and the authority so pronouncing will assume the name and tone of philosophy, that there was nothing more in the whole matter than artful contrivance; that there was no intervention of an intelligent agency extraneous to that of the immediate ostensible agent. But can this assumption be made on any other ground than a prior general assumption that there is no such preternatural intervention in the system of the world? But how to *know* that there is not? The negative decision pronounced in confident ignorance, is a conceited impertinence, which ought to be rebuked by that philosophy whose oracles it is

affecting to utter. For what any man knows, or can know, there may be such intervention. That it is not incompatible with the constitution of the world, is an unquestionable fact with the unsophisticated believers in the sacred records. And not a few occurrences in later history have totally defied every attempt at explanation in any other way."*

And yet sir Gardiner Wilkinson, who subsequently travelled in Egypt, and visited the magician, says :—

"On going to see him, I was determined to examine the matter with minute attention, at the same time that I divested myself of every previous bias, either for or against his pretended powers. A party having been made up to witness the exhibition, we met, according to previous agreement, at Mr. Lewis's house on Wednesday evening, the 8th of December. The magician was ushered in, and having taken his place, we all sat down, some before him, others by his side. The party consisted of colonel Barnet, our consul-general, Mr. Lewis, Dr. Abbott, Mr. Samuel, Mr. Christian, M. Prisse, with another French gentleman, and myself, four of whom understood Arabic very well; so that we had no need of any interpreter. The magician, after entering into conversation with many of us on different subjects, and discussing two or three pipes, prepared for the performance. He first of all requested that a

* Foster's Contributions to the Eclectic Review, vol. i. p. 545.

brazier of live charcoal should be brought him, and, in the mean while, occupied himself in writing upon a long slip of paper five sentences of two lines each, then two others, one of a single line, and the other of two, as an invocation to the spirits. Every sentence began with 'Tuyurshoon.' Each was separated from the one above and below it by a line, to direct him in tearing them apart. A boy was then called, who was ordered to sit down before the magician. He did so, and the magician having asked for some ink from Mr. Lewis, traced with a pen on the palm of his right hand a double square, containing the nine numbers in this order, or in English—making fifteen each way; the centre one being five—the evil number. This I remarked to the magician, but he made no reply. A brazier was brought and placed between the magician and the boy, who was ordered to look stedfastly into the ink, and report what he should see. I begged the magician to speak slowly enough to give me time to write down every word, which he promised to do, without being displeased at the request; nor had he objected, during the preliminary part of the performance, to my attempt to sketch him as he sat. He now began an incantation, calling on the spirits by the power of 'our lord Soolayman,' with the words 'tuyurshoon' and 'haderoo' (be present) frequently repeated.

"He then muttered words to himself, and tearing apart the different sentences he had

written, he put them, one after another, into the fire, together with some frankincense. This done, he asked the boy if any one had come. *Boy.* 'Yes, many.'—*Magician.* 'Tell them to sweep.'—*B.* 'Sweep.'—*M.* 'Tell them to bring the flags.'—*B.* 'Bring the flags.'—*M.* 'Have they brought any?'—*B.* 'Yes.'—*M.* 'O. what colour?'—*B.* 'Green.'—*M.* 'Say, Bring another.'—*B.* 'Bring another.'—*M.* 'Has it come?'—*B.* 'Yes, a green one.'—*M.* 'Another.'—*B.* 'Another.'—*M.* 'Is it brought?'—*B.* 'Yes, another green one—they are all green.' This boy was then sent away, and another was brought, who had never before seen the magician, having been chosen with another, by Mr. Lewis, on purpose; but after many incantations, incense, and long delay, he could see nothing, and fell asleep over the ink. The other boy was then called in, but he, like the other, could not be made to see anything; and a fourth was brought in, who had evidently acted his part before. He first saw a shadow, and was ordered to 'tell him to sleep;' and, after the flags and the sultan as usual, some one suggested that lord Fitzroy Somerset should be called for. He was described in a white Frank dress, a long, high, white hat, *black stockings*, and white gloves, tall, and standing before him *with black boots*. I asked how he could see his stockings with boots? The boy answered, Under his trowsers.' He continued, 'His eyes are white, moustaches, no beard, but little

whiskers, and yellow or light hair; he is thin, thin legs, thin arms; in his left hand he holds a stick, and in the other a pipe; he has a black handkerchief round his neck, his throat buttoned up, his trowsers are long, he wears green spectacles.' The magician, seeing some of the party smiling at the description and its inaccuracies, said to the boy, 'Don't tell lies, boy.' To which he answered, 'I do not; why should I?'—*M.* 'Tell him to go.'—*B.* 'Go.' Queen Victoria was next called for, who was described as short, dressed in black trowsers, a white hat, black shoes, white gloves, red coat, with lining, and black waistcoat, with whiskers, but no beard nor moustaches, and holding in his hand a glass tumbler. He was asked if the person were a man or a woman? He answered, 'A man.' We told the magician that it was our queen! He said, 'I do not know why they should say what is false; I knew she was a woman, but the boys describe as they see.'

"From the manner in which the questions were put, it is very evident that, when a boy is persuaded to see anything, the appearances of the sweeper, the flags, and the sultan, are the result of leading questions. The boy pretends or imagines he sees a man or a shadow, and he is told to order some one to sweep: he is therefore prepared with his answer; and the same continues to the end, the magician always telling him what he is to call for, and consequently what he is to see. The descriptions of persons

asked for are almost universally complete failures."

After these and other details, sir Gardiner says, "I am decidedly of opinion that the whole of the first part is done solely by leading questions, and that whenever the descriptions succeed in any point, the success is owing to accident, or to unintentional prompting in the mode of questioning the boys."*

A subsequent traveller, lord Nugent, places the state of the case in a new light:—

"It is enough to say, that not one person whom Abd-el-Kader described bore the smallest resemblance to the one named by us; and all those called for were of remarkable appearance. All the preparations, all the ceremony, and all the attempts at description, bore evidences of such a coarse and stupid fraud, as would render any detail of the proceeding, or any argument tending to connect it with any marvellous power, ingenious art, or interesting inquiry, a mere childish waste of time. How, then, does it happen, that respectable and sensitive minds have been staggered by the exhibitions of this impostor? I think that the solution which Mr. Lane himself suggested as probable is quite complete. When the exhibition was over, Mr. Lane had some conversation with the magician, which he afterwards repeated to us. In reply to an observation of Mr. Lane's to him upon his entire failure, the magician admitted that 'he had often failed

* Wilkinson's Modern Egypt, vol. i. pp. 218—223.

since the death of Osman Effendi ;'—the same Osman Effendi that Mr. Lane mentions in his book as having been of the party on every occasion on which he had been witness of the magician's art, and whose testimony the *Quarterly Review* cites in support of the marvel, which (searching much too deep for what lies very near, indeed, to the surface,) it endeavours to solve by suggesting the probability of diverse complicated optical combinations.

"And, be it again observed, optical combinations cannot throw one ray of light upon the main difficulty, the means of procuring the resemblance required of the absent person. I now give Mr. Lane's solution of the whole mystery, in his own words, my note of which I submitted to him, and obtained his ready permission to make public in any way I might see fit. This Osman Effendi, Mr. Lane told me, was a Scotchman, formerly serving in a British regiment, who was taken prisoner by the Egyptian army during our unfortunate expedition to Alexandria, in 1807; that he was sold as a slave, and persuaded to abjure Christianity, and profess the Mussulman faith; that, applying his talents to his necessities, he made himself useful by dint of some little medical knowledge he had picked up on duty in the regimental hospital; that he obtained his liberty at the instance of the Sheik Ibraim, (M. Burckhardt,) through the means of Mr. Salt; that, in process of time, he became second interpreter

of the British consulate; that Osman was, very probably, acquainted, by portraits or otherwise, with the general appearance of most Englishmen of celebrity, and certainly could describe the peculiar dresses of English professions, such as army, navy, church, and the ordinary habits of persons of different professions in England; that, on all occasions when Mr. Lane was witness of the magician's success, Osman had been present at the previous occasions, had heard who should be called to appear, and so had, probably, obtained a description of the figure, when it was to be the apparition of some private friend of persons present; that, on these occasions, he very probably had some pre-arranged code of words, by which he could communicate secretly with the magician. To this it must be added, that his avowed theory of morals was, on all occasions, that 'we did our whole duty if we did what we thought best for our fellow-creatures and most agreeable to them.' Osman was present when Mr. Lane was so astonished at hearing the boy describe very accurately, the person of M. Burckhardt, with whom the magician was unacquainted, but who had been Osman's patron, and who, also, knew well the other gentleman whom Mr. Lane states in his book that the boy described as appearing ill and lying on a sofa, and Mr. Lane added that he had, *probably*, been asked by Osman about that gentleman's health, whom Mr. Lane then knew to be suffering under an attack of rheumatism. He concluded, there-

fore, by avowing that there was no doubt in his mind, connecting all these circumstances with the declaration the magician had just made, that Osman had been the confederate. Thus I have given in Mr. Lane's words, not only with his consent, but at his ready offer, what he has no doubt is the explanation of the whole of the subject which he now feels to require no deeper inquiry; and which has been adopted by many as a marvel upon an exaggerated view of the testimony that he offered in his book before he had been convinced, as he now is, of the imposture. I gladly state this, on the authority of an enlightened and honourable man, to disabuse minds that have wandered into serious speculation on a matter which I cannot but feel to be quite undeserving of it."*—So true is it, that, while many effects, which appear mysterious to the multitude, may be explained by those of greater knowledge, others, which, for a time, defy penetration, are, at length, clearly exhibited in their true light. It becomes us, therefore, carefully to examine testimony, to receive that only which will bear scrutiny, and to suspend our judgment whenever we are unacquainted with the *whole* case. The best of men are prone to err; and well is it, if, ceasing from them, we have been led by Divine grace to trust implicitly in the God of truth.

* Lord Nugent's "Lands Classical and Sacred."

CHAPTER III.

Machines considered magical in ancient times—Remarkable modern automata—Minute engines—The calculating machine.

The light of modern science has revealed to us many important secrets. In the dark ages there were but few books; it was then the fashion to write them in Latin; and as, from their costliness, they could only be obtained by men of wealth, so they could be understood alone by such as had enjoyed the advantages of education. Science is now easily accessible, but, though it is not necessary for us all to become philosophers, there is no good reason why people generally should not be acquainted with some of the most remarkable phenomena of the natural world. The inspired psalmist has said, "The works of the Lord are great, sought out of all them that have pleasure therein;" and it becomes all, according to their means and opportunities, to lay this truth to heart. We proceed now to consider some effects regarded as magical, which are satisfactorily explained on natural principles, beginning with mechanics.

An ability to construct wonderful or magical machines was manifest among the ancients. Archytas, a native of Tarentum, in Italy, who lived four hundred years before the birth of our Lord and Saviour, is said to have made a wooden dove, which flew and sustained itself for some time in the air. Other clever contrivances are also mentioned. "A magician," says D'Israeli, "was annoyed, as philosophers still are, by passengers in the street; and he, particularly so, by having horses led to drink under his window. He made a magical horse of wood, according to one of the books of Hermes, which perfectly answered his purpose, by frightening away the horses, or, rather, the grooms! The wooden horse, no doubt, gave some palpable kick."

It is worthy of remark, that tales of ancient times must be received with caution. We find it necessary, even at a much later period. The tricks which now amuse or astonish the populace at a country fair, would be greatly exaggerated in a credulous age, and often assume even the most portentous colouring. Nor is it difficult to guess, and sometimes to discover, the stages of similar and great mystifications. The following instance is rather remarkable. On Charles v. entering Nuremberg, a celebrated German astronomer, whose real name was Johann Müller, but who styled himself Regiomontanus, exhibited some automata which he had constructed. These were an eagle of wood, which, placed on the gate of the

city, rose up and flapped its wings, while the emperor was passing below; and a fly, made of steel, which walked round a table. Now all this is sufficiently credible. But what is the record of the chroniclers only a few years after? That the wooden eagle sprang from the tower and soared in the air; and that the steel fly flew three times round the emperor, and then alighted buzzing on his hand!

In many instances, the mechanism of modern times is surprisingly minute. A watchmaker in London presented his majesty George III. with a repeating watch he had constructed, set in a ring. Its size was something less than a silver two-pence; it contained one hundred-and-twenty-five different parts, and weighed, altogether, no more than five pennyweights and seven grains!

In an exhibition of Maillardet, which the writer has seen, the lid of a box suddenly flew open, and a small bird of beautiful plumage started forth from its nest. The wings fluttered, and the bill opening with the tremulous motion peculiar to singing birds, it began to warble. After a succession of notes, whose sound well filled a large apartment, it retired to its nest, and the lid closed. Its performances occupied about four minutes. In the same exhibition were an automatic spider, a caterpillar, a mouse, and a serpent; all of which exhibited the peculiar movements of the living creatures. The spider was made of steel: it ran on the surface of a table for three minutes, and its course

tended towards the middle of the table. The serpent crawled about in every direction, opened its mouth, hissed, and darted forth its tongue.

Several years ago, a watchmaker, residing in a town in which the writer lived, made a working model of a steam-engine, the packing-case of which was a walnut-shell. On showing it one day to a gentleman, the machine was suddenly stopped, the mechanic remarking, "There is something wrong in one of the safety-valves." "Safety-valve!" exclaimed the observer; "I have not yet been able to detect the fly-wheel!"

The most curious specimen of minute workmanship, however, with which we are acquainted, is a high-pressure engine, the work of a watchmaker having a stand at the Polytechnic Institution, and first exhibited in 1845. Each part was made according to scale, it worked by atmospheric pressure, in lieu of steam, with the greatest activity, yet it was so small, that it stood on a fourpenny-piece, with ground to spare, and, with the exception of the fly-wheel, it might be covered with a thimble.

D'Alembert describes a flute-player, constructed by Vaucanson, which he saw exhibited at Paris in 1738. The writer has also seen one, in which a figure appeared seated, and then rose and played a tune, the motions of the fingers seeming to accord with the notes. He cannot answer for the music having been produced by the movements of the hands of the

automaton. D'Alembert affirms, however, that the automaton of Vaucanson really projected the air with its lips against the embouchure of the instrument, producing the different octaves by expanding and contracting their openings, giving more or less air, and regulating the tones by its fingers, in the manner of living performers. The height of the figure, with the pedestal, containing some of the machinery, was nearly six feet; it commanded three octaves, several notes of which musicians find it difficult to produce. Some years ago, two automaton flute-players were exhibited in this country, of the size of life, which performed ten or twelve duets. That they actually played the flute might be proved, by placing the finger on any hole that was unstopped for a moment by the automata.

M. Vaucanson produced a flageolet-player, who beat a tambourine with one hand. The flageolet had only three holes, and some notes were made by half-stopping these. The lowest note was produced by a force of wind equal to an ounce, the highest by one of fifty-six French pounds. A duck was, however, considered to be his chef-d'œuvre; it dabbled in the mire, swam, drank, quacked, raised and moved its wings, and dressed its feathers with its bill; it even extended its neck, took barley from the hand and swallowed it, during which process the muscles of the neck were seen in motion, and it also digested the food by means of materials provided for its solution in the

stomach. The inventor made no secret of the machinery, which excited, at the time, great admiration.

Maelzel, the inventor of the metronome, or time-measurer, frequently used to aid pupils in music, exhibited in Vienna in 1809, another automaton of singular power; which appeared in the uniform of a trumpeter in the Austrian dragoon regiment Albert, with his instrument placed to his mouth. When the figure was pressed on the left shoulder, it played not only the Austrian cavalry march, and all the signals of that army, but also a march and allegro by Weigl, which was accompanied by the whole orchestra. The dress of the figure was then changed into that of a French trumpeter of the guards, when it began to play a French cavalry march, all the signals, the march of Dussek, and an allegro of Pleyel, accompanied again by the full orchestra. Maelzel publicly wound up his instrument only twice on the left hip. The sound of the trumpet was pure and peculiarly agreeable.

About thirty years ago, Maillardet exhibited, in Spring Gardens, a variety of automata, which the writer had an opportunity of seeing at a later period. One was the figure of a boy, who wrote sentences, and drew certain objects with remarkable promptitude and correctness. Another was a pianiste, seated at a piano-forte, on which she played eighteen tunes. All her movements were graceful. Before beginning a tune, she made a gentle inclination of the head

to her auditors; her bosom heaved, and her eyes followed the motion of her fingers over the finger-board. When the automaton was once wound up, it would continue playing for an hour; and the principal part of the machinery employed was freely exposed to public view. It has been doubted whether the music was actually produced by the automaton: since the time now referred to, the writer has examined another, in which the keys of the instrument were certainly acted upon by the touch.

He has also seen, at various times, several very curiously constructed automata: the figure of a lady, who could walk along a level surface, throwing out the limbs, and moving the head from side to side; a tippler, who could pour out wine from a decanter into a glass, open his mouth, and swallow the fluid, and thus proceed till the bottle was drained; and a performer on the slack rope, whose exceedingly rapid movements of the body, the arms, and the head, all consistent and graceful, were truly amazing.

A very beautiful automaton was exhibited, a few years ago, in Paris, and subsequently in London. It appeared in a court suit, sitting at a table, in the attitude of writing. Several questions, inscribed on tablets, were placed on the table on which the whole apparatus stood, and visitors might select any one or more at pleasure. The tablet, containing a question, on being handed to the attendant, was placed in

a drawer, and, as soon as it was closed, the figure traced on paper an appropriate reply. On the question being given, "Who may be volatile without a crime?" the answer was, "A butterfly." And as the figure could draw a response as well as write it, when the question was put, "What is the symbol of fidelity?" it drew, in outline, the form of a greyhound. In the same way it proceeded throughout the series of questions.

In some instances, the effect of automata is increased by the exhibiter proposing certain questions, and receiving responses from the figure—as shaking the head, to denote a negative; or nodding, to indicate assent. It is evident that here the inquiries or remarks are thrown in to accord with the motions that the figure is contrived to make. When, however, a performer, as one has recently done, puts a whistle in the mouth of an automaton, and then, sitting down by its side, plays a tune on a guitar, desiring the figure to accompany him; the hasty sounds with which the figure seems inclined to begin, the irregularity with which it proceeds, and the long and loud closing note, may all be easily supplied by some confederate. Surprising as are the effects produced by many automata, it would be wrong to infer that their only results are the wonder of the multitude, or gain or applause to their inventors. "They gave rise," as sir David Brewster has remarked, "to the most ingenious mechanical devices, and introduced, among the higher

order of artists, habits of nice and accurate execution in the formation of the most delicate pieces of machinery." Those combinations of wheels and pinions, which almost eluded observation, "reappeared in the stupendous mechanism of our spinning-machines and our steam-engines. The elements of the tumbling puppet were revived in the chronometer, which now conducts our navy through the ocean; and the shapeless wheel which directed the hand of the drawing automaton (of Maillardet,) has served, in the present age, to guide the movements of the tambouring-engine. Those mechanical wonders, which in one century enriched only the conjurer who used them, contributed in another to augment the wealth of the nation; and those automatic toys which once amused the vulgar, are now employed in extending the power, and promoting the civilisation of our species. In whatever way, indeed, the power of genius may invent or combine, and to whatever bad or even ludicrous purposes that invention or combination may be originally applied, society receives a gift which it can never lose; and though the value of the seed may not at once be recognised, though it may lie long unproductive in the ungenial soil of human knowledge, it will, some time or other, evolve its germ, and yield to mankind its natural and abundant harvest."*

A singular fact is connected with the early history of the Astronomical Society of London.

* Natural Magic, p. 286.

A valuable set of tables, for reducing the observed to the true places of stars, was in course of preparation, at the expense of the society, including above three thousand stars, and comprehending all known to those of the fifth magnitude, inclusive, and all the most useful of the sixth and seventh. An incident which now occurred, gave rise to one of the most extraordinary of modern inventions. To insure accuracy in the calculation of certain tables, separate computers had been employed; and two members of the society having been chosen to compare the results, detected so many errors, as to induce one of them to express his regret that the work could not be executed by a machine. For this, the other member, Mr. Babbage, at once replied, that "this was possible;" and, persevering in the inquiry which had thus suggested itself, he produced a machine for calculating tables with surprising accuracy.

The calculating part of the machinery occupies a space of about ten feet broad, ten feet high, and five feet deep. It consists of seven steel axes, erected over one another, each of them carrying eighteen wheels, five inches in diameter, having on them small barrels, and inscribed with the symbols 0, 1, to 9. The machine calculates to eighteen decimal places, true to the last figure; but, by subsidiary contrivances, it is possible to calculate to thirty decimal places. Mr. Babbage has since contrived a machine, much more simple in its construction, and far more extensive in its application.

In thus enumerating various displays of mechanical genius, we are reminded that the prophet Isaiah, after describing the diverse labours of the husbandman, adds, "This also cometh forth from the Lord of hosts, which is wonderful in counsel, and excellent in working." In all the evidence we have of human talent, then, let us acknowledge that "every good gift and every perfect gift is from above, and cometh down from the Father of lights, with whom is no variableness, neither shadow of turning," Jas. i. 17. Would that the gifts of God were always used for the Divine glory!

CHAPTER IV.

Terrestrial phenomena—Footmarks on rocks—The Logan stone—Sounds in stones—The cave of St. Paul—Atmospherical phenomena—Intermitting springs—Waters of magical power.

In proceeding to illustrate the operation of natural laws, we may look now at some of the phenomena connected with the globe we inhabit, of which, where little knowledge is possessed, erroneous and frequently superstitious opinions are still entertained.

Marvellous tales are often told of rocks. There is, for example, a tradition of a nobleman being engaged in the chase, or pursued by his enemies, without being hurt; whose horse left the prints of his feet on a mass of stone, over which he passed. But, unhappily for the tale, other impressions have been observed besides those of the horse's feet; and it is affirmed by various naturalists, deserving of credit, that they must have been made by very different animals, at a remote period, before the stone had completely hardened. Other instances of the same kind might easily be given. In the British Museum, there is a slab having similar impressions, obviously produced

by the same means. It was dug from a great depth; a mass of stone, many feet in thickness, having been formed above the layer which received, in a soft state, the impression from the feet of several animals.

Other impressions, of which we read or hear, are nothing more than tricks of art. Such, most probably, is the impression of the foot of Budda upon the Peak of Adam, at Ceylon; the print of the foot of the idol Gaudama, in the Burmese empire, which has been three times reproduced; and most certainly this is the case with the so-called impressions of the feet of our blessed Lord and Saviour, shown to the present day, on Mount Olivet.

The cave of St. Paul, at Civita Vecchia, the former capital of the island of Malta, is an excavation, about nineteen feet in height, and fifty in circumference; in a soft, white, limestone rock, more friable than chalk. A belief that the stone was endowed with miraculous medical virtues, led people to carry away large quantities of it during the sway of the knights. In 1770, when visited by Brydone, the cave was in the highest celebrity; not only every house in the island had a medical chest of it, but large quantities were sent to different countries in Europe, and even to the East Indies. It was supposed to have a miraculous power which preserved it from diminution; which may be accounted for by a natural law—the calcareous process of formation still going on—while its healing power is to be attributed

to its having some of the properties of magnesia; which leads, according to Dr. Walsh, to its still being given as a purgative-sudorific in eruptive or fever complaints.

One instance of gross superstition, as connected with rocks, is too important to be omitted. The trial by ordeal appears to have been very early practised among the Celtic tribes of Europe, who were always under the influence of an artful and domineering priesthood. Thus, it is said that in cases of doubtful accusation the Druids made use of the rocking-stones which were common in Britain, and that the culprit was acquitted or condemned according as he succeeded or failed in shaking them. Mason alludes to this trial in the following lines:—

> "Behold yon huge
> And unknown sphere of living adamant,
> Which, poised by magic, rests its central weight
> On yonder pointed rock; firm as it seems,
> Such is its strange and virtuous property,
> It moves obsequious to the gentlest touch
> Of him whose heart is pure; but to a traitor,
> Though e'en a giant's prowess nerved his arm,
> It stands as fixed as Snowdon."

A little knowledge would have disabused the mind of this delusion. The celebrated Logan or Logging-stone, near the Land's End in Cornwall, is an immense block, weighing about sixty tons. The surface in contact with the under rock is, however, of very small extent; and the whole mass is so nicely balanced, that, notwithstanding its magnitude, the strength of a single man is sufficient to make it oscillate,

when applied to the under edge. It is the nature of granite to disintegrate or decompose by the action of the air and moisture; a huge mass is thus split into several blocks, and at length, by the continued operation of the elements, one is suspended on the rest.

Sounds emitted from rocks have often been regarded as portentous. Mr. G. Bennett, when at Macao, had his attention directed to a mass of granite rocks, appearing as if separated by some convulsion of nature, many of which were found, when trodden on, to be movable. The first, and by far the most sonorous, was

partially excavated underneath; and, by striking it upon the upper part, a deep sound, "like that of a church bell," was produced. "The battered appearance of the stone above," it is said, "bore several proofs of how many visitors had made this lion roar." Many of the other rocks were also sonorous, but not so loud as the first, and, from their situations, "they were movable when trodden on; but it could not be seen, whether, like the preceding, they were excavated, and, in consequence of being so, sonorous."

In the chain of El-Heman, and not far from the Red Sea, is the Jebal Narkous, or "Mountain of the Bell." It forms one of a ridge of low calcareous hills, which are connected by a sandy plain, extending, with a gentle rise, to their base. It is composed of a light-coloured friable sandstone, about the same as the rest of the chain; but an inclined plane of almost impalpable sand rises at an angle of about forty degrees with the horizon, and is bounded by a semi-circle of rocks, presenting broken, abrupt, and pinnacled forms, and extending to the base of this remarkable hill. Its height is about four hundred feet.

Lieutenant Wellsted observed, that the shape and arrangement of the rocks resembled, in some respects, a whispering-gallery; but he ascertained, by experiment, that their irregular surface rendered them but ill-adapted for the production of an echo. Seated on a rock at the base of the sloping eminence, he directed a Bedouin to ascend; and it was not till he had

reached some distance that the lieutenant perceived the sand in motion, rolling down the hill to the depth of a foot. It did not, however, descend in one continued stream, but, as the Arab scrambled upwards, it spread out laterally and above, until a considerable portion of the surface was in motion. As the sand began to fall, the sounds produced might be compared to the faint strains of an Eolian harp when its strings first catch the breeze. When the sounds became more violently agitated by the increased velocity of the descent, the noise more nearly resembled that produced by drawing the moistened fingers over glass. As it reached the base, the reverberations attained the loudness of distant thunder, causing the rock on which lieutenant Wellsted was seated to vibrate; and the camels, animals not easily frightened, became so alarmed, that their drivers could only retain them with difficulty. The noise, it was remarked, did not issue from every part of the hill alike, the loudest being produced by disturbing the sand on the northern side, about twenty feet from the base, and about ten from the rocks that bound it in that direction. The tradition is, that the bells of a convent were buried here; the Bedouins trace the sounds to several wild and fanciful causes; but, in the experiment now described, it was evident that the sounds sometimes fell quicker on the ear, and at other times were more prolonged, according to the Arab's increasing or retarding the velocity of his descent.

Dr. Chladni made many curious experiments on the figures assumed by sand and similar substances, when strewed over vibrating sonorous bodies. The reader may easily try an experiment of this kind. Let a square piece of glass be taken, such as that used for windows, not less than four or five inches over, the edges of which are to be smoothed by grinding. Spread over the plate, as evenly as possible, a little sand, and, holding it between the thumb and fore-finger, in the middle, pass the bow of a violin against one of its edges, drawing it either upwards or downwards, in a direction perpendicular to its surface. A tremulous motion will be immediately observed, and the sand will assume some particular and fixed figure. If the bow be passed over the middle of one of the sides, the sand will arrange itself in the direction of the two diagonals, dividing the square into four isosceles triangles. If the bow be applied at any point which is one-fourth the length of the square from any angle, the arrangement of the sand will represent the two diameters of the square, dividing it into four equal figures of the same form. If the square be held at the two extremities of either diameter, and the bow be applied to the extremities of the other diameter, the sand will take the figure of an oval, having its major axis in the same direction as one of the diameters.

Other experiments of the same kind have since been made by M. Voigt, and also by the celebrated Oersted. The latter covered a plate

of metal or glass with the lycopodium seed, or the seed of the club-moss, instead of sand; he then tried to produce a sound in the manner of Chladni, and instantly he saw the dust distribute itself into a number of little regular tumuli, which put themselves in motion at their extremities, or formed the figures discovered by this naturalist. They always ranged themselves in the form of a curve, the convexity of which was in proportion to the point touched by the violin bow, or towards the point which has an analogous situation; the nearer that each of these little heaps was to these points, the greater was its height, a circumstance which gave remarkable regularity to the figure. The interior of the small elevations thus obtained, were in constant motion during the continuance of the sound, and the duration of the vibrations might be observed on a plate from four to six inches in diameter. At one moment the height increased, at another it diminished, and the dust had the appearance of arranging itself in small globules, which rolled one above another.

We may now return from these very interesting facts, to others on a far larger scale. Near the Kom-el-Hett'an, or the mound of sand-stone, which makes the site of one of the palaces and temples of Amunoph III., are two sitting colossi, which seem to assert the grandeur of ancient Thebes. The easternmost of the two is doubtless the statue reported by ancient authors to utter a sound at the rising

of the sun. It was said to resemble the breaking of a metallic ring, or harp-string. The superstition of its Roman visitors ascribed the colossus to Memnon, and a multitude of inscriptions attributed to him miraculous powers. The memory of its daily performance is still retained in the traditional appellation of Salamat, "salutations," by the modern inhabitants of Thebes. It is said to have "saluted" the emperor Adrian and his queen Sabina twice; but some persons, of course of humble rank, were disappointed on their first visit, and obliged to return another morning to satisfy their curiosity.

And yet there is ample reason to believe that the whole was an artifice of the priests. In the lap of the statue is a stone; and as sir Gardiner Wilkinson discovered, on examining the inscriptions, that one Ballilla had compared the sound the stone emitted, when struck, to the striking of brass, he determined to put the matter to the test. Accordingly, posting some peasants below, and ascending to the lap of the statue, he struck the sonorous block with a small hammer, and inquiring what was heard by the peasants, they answered, "You are striking brass." "This," says sir Gardiner, "convinced me that the sound was the sound that deceived the Romans, and led Strabo to observe that it appeared to him as the effect of a slight blow." "The Theban priests," he adds, "must have been considerable gainers by the credulity of those who visited their *lion*."

The reader who may have taken the delightful walk from Tunbridge Wells to the High Rocks, and examined particularly those huge masses, will not fail to remember the one called "the Bell Rock." On entering the space between this one and the next, it may be struck with a stick, when a sound will be heard like that produced, on a large metallic body being smitten.

In the road cut by Napoleon between Savoy and France, and about two miles from Les Echelles, there is a gallery twenty-seven feet high and broad, and nine hundred and sixty feet in length, formed in the solid rock. When this road was nearly complete, and the excavations commenced at each end almost met, the partition was broken through by a pick-axe, and a loud and deep sound was heard. We are indebted to Mr. Bakewell for the following solution of this phenomenon. The mountain rises full one thousand feet above the passage, and fifteen hundred above the valley. The air, on the eastern side of the mountain, is sheltered both on the south and west from the sun's rays; and consequently must be much colder than on the western side. The mountain, therefore, formed a partition between the hot air of the valley, and the cold air of the ravines on the eastern side. When the opening was made, the cold, and therefore denser air, rushed into that rarefied by heat, and a loud report was produced, in the same manner as when a bladder, placed over an exhausted air-pump receiver, is burst.

Baron Humboldt informs us, on credible authority, that subterranean sounds, resembling the tones of an organ, are heard on the banks of the Oroonoko. He supposes that they arise from a difference of temperature between the external atmosphere and the air confined in the crevices of the adjacent granitic rocks. He concludes that, as the temperature of the confined air is greatly increased during the day from the conduction of heat by the rocks; and as the difference of temperature between it and the atmosphere will reach its maximum about sunrise, the sounds are produced by the escaping current.

The following illustrative experiment is not a little curious:—If a tube formed of some elastic and sonorous substance be taken, and a jet of inflamed hydrogen be introduced, a musical sound will be heard. This will take place in a tube closed at one end, if it be large enough to admit a sufficient quantity of atmospheric air to support the combustion of the gas; but if the tube be open at both extremities, the musical sound will be clear and full. Various conclusions have been arrived at in reference to this phenomenon; but they have been set aside by the experiments of Mr. Faraday, who attributes the sounds produced by flames in tubes to a continual series of detonations or explosions.

The first philosopher who exhibited the longitudinal vibration of solids was Dr. Chladni. According to him, the best method of pro-

ducing these vibrations in rods, is by rubbing them, in the direction of their length, with some soft substance, covered with powdered resin, or by the finger. When glass tubes are employed, they should be rubbed with a piece of rag spread over with fine sand, the tube being held by one of the ends.

"In all longitudinal vibrations," says the same writer, "the tones depend merely on the length of the sonorous body, and on the quality of the substance, the thickness and form being of no consideration; yet the tones are not varied by the specific gravity of the vibrating substance; for fir-wood, glass, and iron, give almost the same tone as brass, oak, and the shanks of tobacco-pipes." He also mentions several kinds of longitudinal vibration; in one, to use his own words, "there is a certain point in the middle at which the vibration of each half-stops; in the next there are two, each at the distance of a fourth part from the end; and, in the following, there are three, or more. The tones correspond with the natural series of the numbers 1, 2, 3, 4, etc. If a rod be fastened at one end, during the first kind of longitudinal vibration, the alternate expansion and contraction of the whole rod will take place in such a manner, that they stop at the fixed end; in the next tone there is a resting-point at the distance of one-third from the free end; and in the following there are two. The tones correspond with the numbers 1, 3, 5, 7, and the first of these tones is an octave lower than

the first tone of the same rod when perfectly free."

When examining the nature of sonorous bodies, Dr. Chladni imagined the possibility of producing musical sounds by rubbing glass tubes longitudinally. It, however, became a difficult question to determine in what way an instrument of this kind should be constructed. After much and long-continued unsuccessful thought, he returned home one evening exhausted with walking, and he had scarcely closed his eyes to fall asleep in his chair, when the arrangement he had so long been seeking, occurred to his mind. He soon after completed an instrument, which in every respect answered his expectations.

The euphone, signifying an instrument having a pleasant sound, consists of forty-one fixed and parallel cylinders of glass, equal in length and thickness. In its external appearance it resembles a small writing-desk, which, when opened, presents a series of glass tubes about sixteen inches long, and the thickness of a quill. They are fixed in a perpendicular sounding-board, at the back of the instrument. When used, the tubes are wetted with a sponge, and stroked in the direction of their length with wet fingers; the intensity of the tone being varied by greater or less pressure.

The singular phenomenon of sound occasioned by the vibration of soft iron, produced by a galvanic current, was recently discovered by Mr. Sage, and has been since verified by

the observations of a French philosopher, M. Marian. The experiments were made on a bar of iron, which was fixed at the middle, in a horizontal position, each half being inclosed in a large glass tube. By appropriate arrangements, the galvanic circle was completed; and the longitudinal sound could be distinguished, although it was feeble. The origin of the sound has therefore been ascribed to a vibration in the interior of the iron bar; and to the same cause are probably attributable many phenomena.

We now pass on to the violent agitation of the air, which is often productive of surprising results. A quantity of feathers, for example, was scattered one day over the market-place of Yarmouth, to the great astonishment of a large number of persons assembled there. But what was the cause? The timid considered that the phenomenon predicted some great calamity; the inquisitive indulged in a thousand conjectures; and the curious in natural history sagely accounted for it by a gale of wind in the north, blowing wild-fowl feathers from the island of St. Paul's! Yet, not one of them was right. No guess would explain the cause, and yet it arose from the prank of a frolicsome boy. Astley, afterwards well known as sir Astley Cooper, had taken two of his mother's pillows to the top of the church, and when he had climbed as far as he could up the steeple, he ripped them open, and scattered their contents to the wind.

The *Philosophical Magazine* contains an account of a singular snow phenomenon that occurred in Orkney. The paper was contributed by Mr. Clouston, of Stromness. "One night a heavy fall of snow took place, which covered the plain to a depth of several inches. 'Upon this pure carpet,' says the writer, 'there rested next morning thousands of large masses of snow, which contrasted strangely with its smooth surface.' These occurred generally in patches, from one acre to a hundred in extent, while clusters were often half-a-mile asunder. The fields so covered looked as if they had been scattered over with cart-loads of manure, and the latter covered with snow; but, on examination, the masses were all found to be cylindrical, like hollow fluted rollers, or ladies' swan-down muffs, bearing a strong resemblance to the latter. The largest measured 3½ feet long, and 7 feet in circumference. The centres were nearly but not quite hollow; and by placing the head within when the sun was bright, the concentric structure of the cylinder was apparent. They did not occur in any of the adjoining parishes, and were limited to a space of about five miles. The first idea, as to the origin of these bodies, was, that they had fallen from the clouds, and portended some direful calamity. But, had they fallen from the atmosphere, their symmetry and loose texture must have been destroyed. The writer having examined them, was soon convinced that they

had been formed by the wind rolling up the snow as boys form snow-balls. Their round form, concentric structure, fluted surface, and position with respect to the weather side of eminences, proved this; and it was also evident, from the fact of their lying lengthways, with their sides to the wind; and sometimes their tracks were visible in the snow for twenty or thirty yards in the windward direction, whence they had evidently gathered up their concentric layers."

A correspondent of the *Athenæum*, in a letter, dated Naples, January 3rd, 1847, mentions another very striking phenomenon. He was standing on a cliff overlooking the Mediterranean, accompanied by an Italian friend. The air was perfectly tranquil, and yet in a moment he felt himself grasped and encircled, as it were, by an unseen and irresistible power, and, in spite of his struggles, he felt himself sailing through the air at a balloon speed. After a few moments of his aërial travelling, he was pitched halfway down the cliff into the centre of an empty lime-kiln, not far from the sea. Nor was he alone; there was another heavy fall; for his friend stood opposite him. As they were encircled by a force, equal at all points, though the shock was violent, they fell on their feet, but sank directly to the ground, and there sat gazing at one another, unable either to move or speak. Happily, no bones were broken; but so severe were the internal

injuries experienced, as to confine them to their beds for some time, and they expect the internal effects of their involuntary and dangerous voyage to remain for a considerable time.

As the population of the coasts of the Mediterranean are exceedingly ignorant and superstitious, it is not surprising that the people in the neighbourhood said that the Shal'ombre, the evil spirits, in the lime-kiln, must have drawn the travellers in ; and attributed their deliverance to the intercession of the souls in purgatory for the acts of charity they had performed !

To avoid any calamities, which the mariners of Naples generally attribute to demoniacal influence, they resort to the practice of witchcraft. Few are the barks that venture to the coral fishery, or the coasting-trade, without having a magician on board. Persons of this class, however, who practise the art supposed to be required at sea, or who even reveal it to others, cannot receive absolution from an ordinary confessor. It is comprehended under the head of " malaficia," one of the reserved sins to be found in the printed list of directions appended to every confessional in Italy.

And yet, were witchcraft available in any case, it could not be in connexion with the natural operation, which the mariners call " trombe di mare." The travellers suffered, in fact, from a strong wind, connected with the phenomenon of a waters pout, observed, for the most part, at sea, but sometimes also on shore.

Its usual appearance is that of a dense cloud, like a conical pillar, which seems to consist of condensed vapour, and is seen to descend with the apex downwards. When over the sea, there are generally two cones, one projecting from the cloud, the other from the water below it. They sometimes unite, and then a flash of lightning is observed; on other occasions, they disperse before any junction takes place. The effect appears to be, at least partly, electrical; the cones being in opposite states, the positive and negative attraction ensue; and, when union takes place, which is indicated by the flash, the bodies are restored to their equilibrium.

The magicians on the coast practise what they call the art of "cutting" the "trombe." As soon as it is seen approaching in the direction of a boat, the wizard goes forward, sends all the crew aft, that they may not be eye-witnesses of what he does; and using certain signs or words, and making a movement with his arms as if in the act of cutting, the enemy falls in two, and disappears.

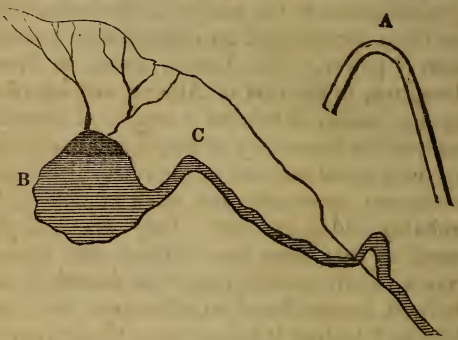
We are reminded by these circumstances of "the news from the country," which the *Spectator* describes as brought to him by sir Roger de Coverley. One part of it was, that Moll White was dead, and that about a month after one of the baronet's barns fell down, which led to the shrewd remark: "I do not think the old woman had anything to do with it." Nor do we think that the wizard of the Mediterranean has anything to do with "cutting the

wind." The probability is, that he seizes on the time for his movements, which, from experience, he knows to precede the dispersion of the cloud, and thus acquires credit to which he has not the slightest claim.

This chapter may appropriately be concluded by a reference to the waters of the earth, which are often represented as endued with a supernatural power. The Ilissus, rising on Mount Hymettus, to the east of Athens, and overflowing its banks, furnishes a supply of excellent water to the monastery of Sergiani. On one side, are three small caverns in the rock, with double entrances; apparently the work of nature, but probably aided by art. They are still supposed, as they have been during past ages, to have a mystic virtue; and "no remedy," says Dodwell, is considered so efficacious for a sick child as "to drag it two or three times from one cave to another; by which it is either killed or cured. Several ancient wells are observed in the rock on each side of the river. Near these, the foundation of a wall crosses the bed of the Ilissus."

Springs, in various parts of this and other countries, alternately ebbing and flowing, have been, and are still, in some cases, supposed to be under the ban of witchcraft. And yet the phenomena are easily explained by natural laws. If the shorter end of a bent tube, A, whose branches are of an unequal length, be placed in a basin of water, and the air is drawn from it, we have a syphon, which will decant the water

into any vessel. Now such tubes as these are naturally formed in the earth, and if the water be drained into a cavity, B, having a syphon-like channel, C, it is evident that it will flow as long as the syphon can act, and it will then cease.



Seneca describes a spring near to Tempe, in Thessaly, the waters of which are fatal to animals, and penetrate iron and copper. Yet, it is probable, as Dr. Thomson states, that "this spring contained either free sulphuric acid, or a highly acidulous salt of that acid. This acid has been detected in a free state, as well as hydrochloric acid, in the water of the Rio Vindagre, which descends from the volcano of Paraiè, in Columbia, South America. Sulphuric acid is also found in the waters of other volcanic regions. The sour springs of Byron, in the Genessee country, about sixty miles south of the Erie canal, contain sulphuric acid.

Such waters would rapidly corrode both iron and copper, converting the former into green, the latter into blue vitriol—sulphates of both metals."*

It would be easy to extend these instances, in connexion with the phenomena of the globe, but the present will suffice to show that a little knowledge of natural science is an antidote to many superstitions. We proceed now to illustrations of agencies in active operation of a different character.

* Philosophy of Magic.

CHAPTER V.

Chemical wonders—Ice obtained in a red-hot vessel—The corpse candles of Wales—Luminous appearances after death—Sadoomeh the magician—The laughing gas—Sulphuric ether—Chloroform—Gunpowder compared with gun-cotton.

THE word chemistry is, probably, derived from a Coptic root, signifying obscure or secret; and the German word *geheim* is traced to the same origin. The objects of this department of science are, to investigate the nature and properties of the elements of matter and their mutual actions and combinations; to ascertain the proportions in which they unite and the modes of separating them when united; and to inquire into the laws which affect and rule these agencies. A few of the wonders connected with this science may, therefore, appropriately follow the terrestrial phenomena which have just been considered.

The Romish church has rendered chemistry available in connexion with one of its prodigies, the so-called blood of St. Januarius. A substance is shown to the deluded worshippers in a phial, appearing in a congealed state; but, as masses are performed by the priests, it becomes fluid.

The illusion practised in this case may, however, be easily effected by reddening sulphuric ether with orchanet, the *onosma* of Linnæus, and then saturating the tincture with spermaceti. This preparation is solid at ten degrees above the freezing point, and melts and boils at twenty degrees. Let the phial which contains it when coagulated, be held in the hand for a few minutes, and the temperature of the substance rises, and it becomes fluid. Even the warmth of a public assembly is sufficient for this purpose.

Marcus, the chief of one of the sects in the second century, who wished to amalgamate with Christianity the doctrines and rules of pagan rites, filled with white wine three cups of transparent glass; and, while he was praying, the liquid in one of the cups became like blood; in another, of a purple colour; and in the third, sky-blue. But these effects might easily be produced by chemical action. Professor Beyruss, at the court of the duke of Brunswick, promised that his white dress should become red during a repast; and the change took place, to the astonishment of the prince and his guests. M. Vogel, who relates this fact, does not reveal the means employed; but observes that, by pouring lime-water on the juice of beet-root, a colourless liquid is obtained, that a piece of cloth dipped in it and quickly dried becomes red in a few hours by the contact of the air alone; and that this effect may be accelerated in a room where champagne and

other beverages charged with carbonic acid gas are abundantly used. Still more rapidly might the change be effected in some temple, in the midst of rising incense and burning torches; and the veil which covered things deemed sacred, might thus have been seen to change from white to the colour of blood—a presage of fearful disasters.

A series of remarkable experiments was performed by professor Boutigny, at the British Association at Cambridge, in 1845. He commenced by showing, that when cold water is poured on a hot metallic surface, the heat is not communicated to it; and that the water assumes a spheroidal form, and continues to roll about, upheld at a minute distance from the heated surface, without boiling. The water was poured into a hot platinum cup kept in rapid motion, and resembled a small globe of glass dancing about. There was no hissing noise nor appearance of steam, though the globule of water must, nevertheless, have evaporated rapidly; for, after gradually diminishing in size, in the course of about two minutes it disappeared. The same result takes place when any substance capable of assuming a globular form is placed on a heated surface. In proof of this, the professor placed in the heated cup of platinum, iodine, ammonia, and some inflammable substances; each of which became globular, and danced about like the globule of water, but without emitting smell or vapour, or being inflamed, until the platinum cup was cooled.

Another experiment was yet more curious. Professor Boutigny heated a silver weight, of the same shape as the weight of a clock, until it was red-hot, and then lowered it by a wire into a glass of cold water, without there being any more indication of action in the water than if the weight had been quite cold. Professor Boutigny advanced no theory to account for these peculiar actions, further than that a film of vapour intervenes between the heated body and the substance, which prevents the communication of heat. The facts, however, he thought were of importance in a practical point of view, both as regards the tempering of metals, and in the explanation of the causes of steam-boiler explosions. It would seem, from experiments in tempering metals, that, if the metal be too much heated, the effect of plunging it into water will be diminished. In steam-boilers, also, if the heated water be introduced into a heated surface, the heat may not be communicated to the water, and the boiler may become red hot, and without any great emission of steam; until, at length, when the boiler cools, a vast quantity of steam would become suddenly generated and the boiler burst.

The last and most curious experiment performed by professor Boutigny, was the freezing of water in a red-hot vessel. Having heated a platinum cup red-hot, he poured into it a small quantity of water, which was kept in a globular form, as in the other experiments. He then

poured into the cup some liquid sulphurous acid; when a sudden evaporation ensued, and, on quickly inverting the cup, there came out a small mass of ice. The principle of this experiment, which called forth loud and continued applause, is this:—sulphurous acid has the property of boiling water when it is at a temperature below the freezing point; and, when poured into the heated vessel, the suddenness of the evaporation occasions a degree of cold sufficient to freeze water.

Liquid carbonic acid takes a high position for its freezing qualities. Mr. Adams, of Kensington, manufactures this curious liquid as an article of commerce, and has, occasionally, as much as nine gallons of it in store. In drawing it from its powerful reservoirs, it evaporates so rapidly as to freeze, and it is then a light porous mass, like snow. If a small quantity of this is drenched with ether, the degree of cold produced is even more intolerable to the touch than boiling water; a drop or two of the mixture producing blisters, just as if the skin had been burned! Mr. Adams states that, in eight minutes he has frozen a mass of mercury weighing ten pounds.

In one department of knowledge—that of vapours and gases—on which chemistry casts so much light, we discover many remarkable phenomena. Few persons have resided, for example, in the fenny and swampy districts of our island, without seeing, at least occasionally, the ignis fatuus, Will-o'-the-wisp, or Jack-o'-lantern,

hovering a few feet above the surface of stagnant water.

"Wild fires dancing o'er the heath,"

may be observed, indeed, at almost all times of the year, but it is chiefly in autumn, and particularly in November, that they flit in mazy circles and irregular evolutions; sometimes at the edge of a morass, over the tops of withered sedges, reeds, and brushwood; and, at others, over palings and hedgerows, or the still surface of the oozy bog.

It has been argued by some, that they are effects produced by luminous insects, as the glow-worm, the gnat, and the mole-cricket. But this theory is very unsatisfactory, and the cause which is now generally acknowledged to be the real one, is far more natural. There is a substance readily obtained, but of very offensive odour, called phosphoret of lime; and, if a piece of this be taken and dropped into a pool of water, little flames will be seen on its surface. These arise from the power of the substance to decompose water, in consequence of which, the hydrogen ascends to the surface, and ignites on coming in contact with the air.

Dr. Weissenborn has given the following interesting statements:—"In the year 1818, I was fortunate enough to get a fine view of the ignes fatui operating on an extensive scale. I was then at Schnepfenthal, in the duchy of Gotha; and in a clear November night, between eleven and twelve o'clock, when

I had just undressed, the bright moonshine allured me to the window, to survey the expanse of boggy meadows, which spread two or three English miles in length, a quarter-of-a-mile from the foot of the hillock on which the house in which I then was, is standing. Through the first third of the meadows there was a winding rivulet, of the breadth of seven or eight feet, which then turns off into an artificial bed, whilst the old bed continues in the direction of the meadows, which are bounded on one side by a range of brushwood, and on the other by cultivated grounds, with marshy dells here and there. My intimate acquaintance with the locality, together with the bright moonshine, enabled me to discover every object round the meadow-ground, sufficiently well to judge of the position and direction of the luminous phenomena, the display of which I saw as soon as I had posted myself at the window. I perceived a number of reddish yellow flames on different parts of the expanse of almost level ground. I descried, perhaps, no more than six at a time, but dying away and appearing in other places so rapidly, that it was impossible to count them; but I should say, on a rough calculation, there were about twenty or twenty-five within a second. Some were small and burned dimly; others flashed with a bright flame, in a direction almost parallel with the ground, and coinciding with that of the wind, which was rather brisk. After having for some time looked with amazement at the brilliant scene, as a whole, I tried

to study its details, and soon found that the flames which were nearest originated in a quagmire, the position of which I knew exactly, by a solitary cluster of willows; and I could trace a succession of flashes from that spot to a certain point of the margin of the wood across the rivulet and meadow. The distance of the two points from each other was more than half-a-mile, and the flames travelled over it, perhaps, in less than a second. The first flash was not always observed in the immediate neighbourhood of the quagmire; but the succession of flames lay always in the same straight line, and in the direction of the wind; whilst other sets were observed, though not with the same distinctness, in the more distant parts of the meadow-ground.

"After about an hour, a bank of mist began to overspread the meadows, but I saw the light still glimmering through it, whilst I dressed myself, in order to examine the phenomenon in its laboratory. However, when I reached the meadows, the atmospheric conditions which gave rise to the ignes fatui had ceased to exist." Weissenborn then expresses his belief that the phosphoric hydrogen gas, exhaled by certain swamps, is kindled into flame by coming in contact with the atmospheric air; but, as the hydrogen is not saturated with phosphorus, (the greater portion of the latter being precipitated in passing through the water as red oxide of phosphorus,) there is a certain electric condition of the atmosphere necessary to cause the com-

bustion. Thus, under common circumstances, the gas is evolved and dissipated without being observed; but when the state of the atmosphere is competent to effect its combustion, the proper degree of electrical tension is lost at the place where the explosion is effected; and, until it is restored, or the gas comes in contact with that layer of the atmosphere which possesses the requisite degree of electrical tension, a considerable body of bog gas may collect, and be carried in the direction of the wind, so as to give rise to a sort of quick fire, with occasional flashes; in those places of the stream of gas where there happens to be a considerable volume of it. The lights, which still frequently excite apprehensions in Wales, and are popularly termed "corpse candles," have the same origin as the "ignes fatui."

At the village of Wigmore, in Herefordshire, there are fields which may be, and two houses which really are, illuminated with a natural gas. This vapour, with which the subjacent strata seem to be charged, is obtained in the following manner:—a hole is made in the cellar of the house, or other locality, with an iron rod; a hollow tube is then placed therein, fitted with a burner similar to those used for ordinary gas-lights, and immediately on applying a flame to the jet, a soft and brilliant light is obtained, which may be kept burning at pleasure. The gas is very pure, quite free from any offensive smell, and does not stain the ceilings, as is generally the case with the manufactured

article. Besides lighting rooms, etc., it has been used for cooking; and, indeed, seems capable of the same applications as prepared carburetted hydrogen. There are several fields in which the phenomenon exists, and children are seen boring holes and setting the gas on fire for amusement. It is now several months since the discovery was made; and a great many of the curious have visited, and still continue to visit, the spot.

If the Chinese are not manufacturers, they are, nevertheless, gas consumers and employers on a large scale; and have evidently been so, ages before the knowledge of its application was acquired by Europeans. Beds of coal are frequently pierced by the borers of salt water; and the inflammable gas is forced up in jets twenty or thirty feet in height. From these fountains, the vapour has been conveyed to the salt-works in pipes, and there used for the boiling and evaporation of the salt; other tubes convey the gas intended for lighting the streets, and the larger apartments and kitchens. As there is still more gas than is required, the excess is conducted beyond the limits of the salt-works, and forms separate chimneys or columns of flame.

A singular counterpart to this employment of natural gas, is witnessed in the valley of the Kanawha, in Virginia. The origin, the means of supply, the application to all the processes of manufacturing salt, and of the appropriation of the surplus for the purposes of illumination, are

remarkably alike at such distant points as China and the United States.

It has sometimes been stated of a departed person, that a luminous appearance was observed to rest upon, and occasionally to surround, a corpse. Such an effect has been described as supernatural—a Divine attestation to extraordinary excellence; and, doubtless, Roman Catholics have made the most of such circumstances in reference to those whom they have denominated saints, and to whom a place has been assigned in their calendar. And yet there was no departure in any such instance from the ordinary laws of nature. Sir H. Marsh, in an essay on "The Evolution of Light from the Human Subject," states, that electric sparks have been known to issue from the skin of some individuals when rubbed lightly and quickly with a linen cloth. Not only has this physician heard of such cases, but two had actually come under his observation.

He was led to consider the subject by the following statement made to him. "About an hour and-a-half before my sister's death, we were struck by appearances proceeding from her head, in a diagonal direction. She was, at the time, in a half-recumbent position, and perfectly tranquil. The light was pale as the moon, but quite evident to mamma, myself, and sisters, who were watching over her at the time. One of us, at first, thought that it was lightning; till, shortly after, we fancied we perceived a sort of tremulous glimmer playing

round the head of the bed; and then, recollecting that we had read something of a similar nature having been observed previous to dissolution, we had candles brought into the room, fearing our dear sister would perceive it, and that it might disturb the tranquillity of her last moments."

A similar appearance around the person, and in the room, of a man who fell a sacrifice to lingering disease in a remote district of the south-west of Ireland, is recorded. All the witnesses agree in having seen the light; many, however, came to the conclusion that it was caused by supernatural agency, and a proof of miraculous interposition, and even evidence of Divine favour. Considerable excitement was occasioned in the south of Ireland by the following case, related by Dr. D. Donavan, in the *Dublin Medical Press*, Jan. 15, 1840:—"I was sent for," the Doctor says, "in December, 1828, to see Harrington. He had been under the care of my predecessor, and had been entered in the dispensary book as a phthisical patient; and, on reference to my note-book, I find that the stethoscopic and other indications of phthisis were indubitable. He was under my care for about five years; during which time, strange to say, the symptoms continued stationary; and I had discontinued my attendance for about two years, when the report became general, that mysterious lights were every night seen in his cabin. The subject attracted a great deal of attention; and, like

everything else in Ireland, at once assumed a sectarian complexion; some attributing the light to the miraculous interference of Heaven; others, to the practice of the black art. Not regarding these views as affording an explanation of the mystery, I determined to subject the matter to the ordeal of my own senses; and, for this purpose, visited the cabin for fourteen nights; and on three nights, only, did I witness anything unusual. Once I perceived a luminous fog, resembling the aurora borealis, and twice I saw the scintillations, like the sparkling phosphorescence sometimes exhibited by the sea infusoria. From the close scrutiny I made, I can, with certainty, say, that no imposition was either employed or attempted. How are these appearances to be accounted for? In answering this question, I would observe, that they are never seen but in cases of extensive disease, and when considerable alteration of structure has taken place. Processes analogous to decomposition are witnessed in the human subject while the living principle remains."

On these, and similar facts, Dr. Marsh remarks: "Disease is but a step toward dissolution, in which the vital powers are impaired; and, unless the malady be checked, by the use of proper means, a period will quickly approach when the chemical action will entirely prevail over the whole frame. Phosphorescent matter may be generated in organic bodies at a period of incipient decomposition; and when

we consider that phosphuretted hydrogen undergoes spontaneous combustion, when brought in contact with the oxygen of the atmosphere, and that the component parts of which this gas is formed exist in the body in great abundance, an easy solution is at hand, accounting for the luminous appearances which have been witnessed in dissecting-rooms, in burial-grounds, and in marine substances, as well as on the approach of dissolution."

The Arabs are well known as believers in wonders; and of one of their magicians, named Sadoomeh, the following story is told. "In order to give one of his friends a treat, he took him to the distance of about half-an-hour's walk into the desert, on the north of Cairo, where they both sat down upon the pebbly and sandy plain; and the magician having uttered a spell, they suddenly found themselves in the midst of a garden, like one of the gardens of Paradise, abounding with flowers and fruit-trees of every kind, springing up from a soil covered with verdure brilliant as the emerald, and irrigated by numerous streamlets of the purest water. A repast of the most delicious viands and fruit was spread before them by invisible hands; and they both ate and drank to satiety, taking copious draughts of the various wines. At length the magician's guest sank into a deep sleep, and when he awoke he found himself again in the pebbly and sandy plain, with Sadoomeh still by his side." "The reader will probably attribute this vision," says Mr. Lane,

who relates the tale, "to a dose of opium or some similar drug; and such I suppose to have been the means employed; for I cannot doubt the integrity of the narrator, though he would not admit such an explanation; regarding the whole as an affair of magic, 'jinn,' or genii."

A story of Gassendi, one of the most distinguished of naturalists, mathematicians, and philosophers of France, in the sixteenth century, will place this solution in a still clearer light. As he was taking a morning walk near Deigne, in Provence, his ears were assailed by repeated exclamations of "A sorcerer! a sorcerer!" On glancing behind him, he beheld a mean and simple-looking man, with his hands tied, whom a mob of the country-people were hurrying to prison. Gassendi's character and learning had given him great authority with them, and he desired to be left alone with the man. They immediately surrendered him, and Gassendi said to him, in private, "My friend, you must tell me sincerely, whether you have made a compact with the devil or not: if you confess it, I will give you your liberty immediately; but, if you refuse to tell me, I will give you immediately into the hands of a magistrate." The man answered, "Sir, I will own that I go to a meeting of wizards every day. One of my friends has given me a drug, which I take to effect this, and I have been received as a sorcerer these three years." He then described the proceedings of these meetings, and spoke of the different devils, as if he

had been all his life acquainted with them. "Show me," said Gassendi, "the drug which you take to attend this infernal meeting, for I intend to go there with you to-night." The man replied, "As you please, Sir; I will take you at midnight, as soon as the clock strikes twelve." Accordingly, he met Gassendi at the appointed hour, and, showing him two boluses, each of the size of a walnut, he desired him to swallow one, as soon as Gassendi had seen him swallow the other, and then they lay down together on a goat-skin. The man soon fell asleep, but Gassendi remained awake and watched him, and perceived that he was greatly disturbed in his slumbers, and writhed and twisted his body about, as if he had been troubled by bad dreams. At the expiration of five or six hours he awoke, and said to Gassendi, "I am sure, Sir, you ought to be satisfied with the manner in which the great goat received you; he conferred on you a high honour when he permitted you to kiss his tail the first time he ever saw you." It was thus apparent that the deleterious opiate had operated upon his imagination. Gassendi, compassionating his weakness and credulity, took pains to convince him of his self-delusion; and, showing him the bolus, he gave it to a dog, who soon fell asleep, and suffered great convulsions. The poor fellow was set at liberty to undeceive his brethren, who had, like him, been lulled by the noxious drug into imagining themselves sorcerers.

In India there is a native plant, which, after

it has flowered, is dried and sold in the bazaars of Calcutta, for smoking. The Hindoos call it "ganpah," and they give the name of "bang" or "subjee" to the large leaves and capsules which they use for the same purpose. The plant is a species of hemp; the smoking of which is considered so delightful, according to Dr. Thomson, as to have been denominated by such epithets as "Assuager of sorrow," "Increaser of pleasure," "Cementer of friendship," "Laughter-mover," and others of the same kind.

On the same authority it is stated, that in Nepaul, the resin only is used; in some places it is collected by native coolies, walking through the fields of hemp at the time the plants give forth the resin, which, adhering to the skin, is scraped off from it, and kneaded into balls. It is taken in doses, from a grain to two grains, and causes a delightful delirium. When repeated, however, it is followed by catalepsy, or that state of insensibility which allows the body to be moulded into any form like a Dutch-jointed doll, the limbs remaining in the position in which they were placed, though contrary to the law of gravity, and continuing so for many hours.

We are well acquainted with various means of acting in an extraordinary manner on the human frame. The writer, in common with multitudes, has witnessed, for example, the operation of nitrous oxide, often called "the laughing-gas." It acts, however, very differently on different persons; some laugh immo-

derately, others become depressed, others assume the airs of vanity and importance which accord with their most cherished dispositions; and some can only be forcibly restrained from deeds of great violence. It is certainly a most singular sight to see a person laughing most boisterously, or strutting with all the hauteur of a newly-made potentate, suddenly subside as the action of the gas ceases, into a very unobtrusive individual.

We may now briefly allude to one of the most extraordinary applications of the present times. The late sir Humphry Davy made many experiments on the effects of various gases on the human lungs. He found, in his own person, that the inhalation of nitrous oxide removed head-ache, and greatly assuaged the pain of cutting a wisdom-tooth. In his works, edited by Dr. John Davy, is the following passage:—

"As nitrous oxide, in its extensive operation, appears capable of destroying physical pain, it may probably be used with advantage during surgical operations in which no great effusion of blood takes place." Here is the germ of the recent application of ether.

"The effects of this inhalation, as indicated by the patient's own recollection," says a writer in the *North British Review*, "are very various. In general they are somewhat as follows:—A pleasing sense of soothing succeeds the first irksomeness of the pungent vapour—a soothing of both mind and body. Ringing in the ears takes place, with some confusion of sight and

intellectual perception. The limbs are felt cold and powerless; the hands and feet first, then the knees; and the feeling is as if these parts had ceased to be peculiar property, and dropped away. This sensation may gradually creep over the whole frame; the patient becoming, in more senses than one, truly etherealized; reduced to the condition of no body and all soul. The objects around are either lost sight of or strangely perverted; fancied shadows flit before the eyes, and then a dream sets in—sometimes calm and placid, sometimes active and bustling, sometimes very pleasurable, sometimes frightful, as a nightmare. Emerging, the figures and scenes shift rapidly, and grow fainter and fainter; present objects are caught by the eye once more, the ringing of the ears is heard again, consciousness and self-control return, a tendency to excited talking is very manifest, movement is unsteady, and, both in mind and body, a kind of intoxication is declared. It is, however, of a light and airy kind; very pure, very pleasant, and very passing, and, when gone, leaving very little trace behind.

"Experience has fully shown that the brain may be acted on so as to annihilate, for the time, what may be termed the faculty of feeling pain; the organ of general sense may be lulled into profound sleep, while the organ of special sense, and the organ of intellectual function remain wide awake, active, and busily employed. The patient may feel no pain under

very cruel cutting, and yet he may see, hear, taste, and smell, as well as ever, to all appearance; and he may also be perfectly conscious of everything within reach of his observation—able to reason on such events most lucidly, and able to retain both the events and the reasoning in his memory afterwards. We have seen a patient following the operator with her eyes most intelligently and watchfully, as he shifted his place near her, lifted his knife, and proceeded to use it; wincing not at all during its use; answering questions by gesture, very readily and plainly; and, after the operation was over, narrating every event as it occurred; declaring that she knew and saw all; stating that she knew and felt that she was being cut, and yet that she felt no pain whatever. Patients have said, quietly, 'You are sawing now,' during the use of the saw in amputation; and afterwards they have declared most solemnly, that though quite conscious of that part of the operation, yet they felt no pain. We have seen a patient enduring amputation of a limb without any sign of suffering, opening her eyes during the performance, at its most painful part, descrying a country practitioner at some distance—under whose care she had formerly been, and whom she had not seen for some considerable time—addressing him by name, and requesting that he might not leave town without seeing her."

Since the period to which the writer just quoted refers, Dr. Simpson, of Edinburgh, has

discovered a substitute for sulphuric ether—chloroform, or the perchloride of formyle. It is stated to possess over sulphuric ether the following advantages:—1. A greatly less quantity of chloroform than of ether is requisite to produce the desired effect. 2. Its action is much more rapid and complete, and generally more enduring. 3. The inhalation and influence of chloroform are far more agreeable and pleasant than those of ether. 4. The use of chloroform is less expensive than that of ether. 5. Its odour is not unpleasant; nor does it exhale in a disagreeable form from the lungs of the patient, as so generally happens with sulphuric ether. 6. Being required in much less quantity, it is much more portable and transmissible than sulphuric ether. 7. No special kind of inhaler or instrument is necessary for its exhibition. A little of the liquid diffused upon the interior of a hollow-shaped sponge, or on a pocket-handkerchief, or a piece of linen or paper, or held over the mouth and nostrils, so as to be fully inhaled, generally suffices, in about a minute or two, to produce the effect. This agent, however, requires to be used to annul pain under the direction of a judicious medical practitioner; it may otherwise be productive of serious consequences.

A prodigious force often arises from chemical affinity. Of this, gunpowder presents a familiar instance. It is formed of nitre, sulphur, and charcoal, which, in the ordinary state, are only combined mechanically; but no sooner is this

compound ignited, than these substances are brought, by chemical action, into such close contact, as to evolve a mighty and destructive power It seemed likely to be thrown into the shade by the discovery of gun-cotton as an explosive agent, which excited extraordinary interest throughout Europe. On projectile experiments being made, a gun, charged with thirty grains of prepared cotton, propelled an equal charge of shot, with greater force and precision, at a distance of forty yards, than were gained by the same gun loaded with a hundred-and-twenty grains of gunpowder. A rifle, charged with fifty-four and-a-half grains of gunpowder, sent a ball through seven boards, half-an-inch in thickness, at a distance of forty yards; the same rifle, charged with forty grains of gun-cotton, caused the ball to enter the eighth board. Another rifle, which had been used for elephant-shooting, and consequently carried a much larger ball, charged with forty grains of gun-cotton, forced the ball through eight boards, at a distance of ninety yards. In no case was the discharge accompanied by a greater recoil than usual; and the reports were not louder than those accompanying the discharge of guns and rifles loaded with gunpowder. According to the specification of the patentee, M. Schönbein, cotton is preferred for this purpose, freed from extraneous matters; and it is considered desirable to operate on the clean fibres of the cotton in a dry state, by means of nitric and sulphuric acids. These are mixed together in

the proportion of one measure of nitric acid to three measures of sulphuric acid, in any suitable or convenient vessel not liable to be affected by the acids. A great degree of heat being generated by the mixture, it is left to cool until its temperature falls to sixty or fifty degrees Fahrenheit. The cotton is then immersed in it; and, in order that it may become thoroughly saturated with the acids, it is stirred with a rod of glass, or other material, not affected by the acids. The cotton should be introduced in as open a state as practicable. The acids are then poured or drawn off, and the cotton gently pressed by a presser of glazed earthenware, to take out the acids, after which it is covered up in the vessel, and allowed to stand for about an hour. It is subsequently washed in a continuous flow of water, until the presence of the acids is not indicated by the ordinary test of litmus paper. To remove any uncombined portions of the acids which may remain after the cleansing process, the patentee dips the cotton in a weak solution of carbonate of potash, composed of one ounce of carbonate of potash to one gallon of water, and partially dries it by pressing, as before. The cotton is then highly explosive, and may be used in that state; but, to increase its explosive power, it is dipped in a weak solution of nitrate of potash, and, lastly, dried in a room heated by hot air, or steam, to about one hundred and fifty degrees Fahrenheit.

The advantages and disadvantages of this

substance have thus been stated by professor Brande:—"The disadvantages are, that the effects are less regular than those of gunpowder; that it is more dangerous, because inflaming at a lower temperature; that it does not take fire when compressed in tubes; that it burns slowly in all kinds of cartridges; that guns and pistols must be altered to admit of its use; that it is not adapted for the use of the army; that the barrel of the gun is moistened by the water produced during combustion. The advantages, on the other hand, may be stated as follows:—Its extreme cleanliness, leaving no residue after combustion; its freedom from all bad smell; the facility and the safety of its preparation; the possessing treble the force of gunpowder; its explosion producing no smoke, and less noise than that of gunpowder; its filamentary nature admitting of its being used over head in mining operations; its not being liable (as a granulated substance is) to the accidents of leakage; its occasioning very little recoil."—Every benevolent mind must wish to hear no more of "the confused noise of battle and of garments rolled in blood;" and that the time may soon arrive when men shall "beat their swords into ploughshares, and their spears into pruning-hooks;" when "they shall learn war no more," but yield themselves heartily and devotedly to the benignant sway of the Prince of peace. There seems, however, no reason to conclude that gun-cotton will be employed for any hostile purpose, the Board of

Ordnance having definitely decided against its adoption in the military and naval services. The principal objection to it is, the very low temperature at which it explodes. The mere heating of a gun, from a number of charges successively fired, has been proved sufficient to cause an instant explosion of gun-cotton.

In mining, it is likely to be of great use. In the slate-quarries at Penrhyns it has been found far superior to gunpowder. A huge mass of sixty tons' weight, for instance, was gently pushed from its firmly compacted bed by the explosion of only eight ounces of cotton, while the slate was not splintered. In other great works it will also be of service. In a cutting on the Syston and Peterborough railway, not far from Stamford, experiments showed the average powers of the gun-cotton to be in the proportion of one to six of gunpowder; so that, in a hard freestone foundation, about five feet thick, and with an entire depth of twenty-eight feet, where six holes were necessary for gunpowder, only one was required for gun-cotton. In all blasting operations, whether in open cuttings, tunnels, or deep mines, a great saving of time, labour, and cost, is thus likely to be effected.

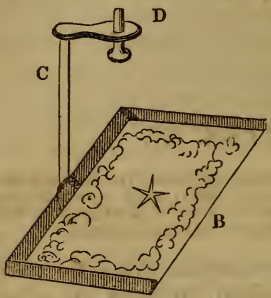
CHAPTER VI.

Light and its phenomena—Magic pictures—The optical paradox—Chinese metallic mirrors—Effect of an optical instrument on a superstitious mind—Origin of photography—The Talbotype—The Daguerreotype—Sunlight pictures.

The cause of those sensations which we refer to the eyes, or that which produces the sense of seeing, is light. The phenomena of vision have always been regarded as among the most interesting branches of natural science. The knowledge of the laws which regulate the phenomena of light, constitutes the science of optics, which explains the cause of many most striking illusions.

Magic pictures have been produced, which, when seen in a certain point through a glass, exhibit an object different from that be held by the naked eye. Niceron tells us that he executed at Paris, and deposited in the library of the Minimes of the Place Royale, a picture of this kind; when seen by the naked eye, it represented fifteen portraits of Turkish sultans, but, when viewed through the glass, it was a portrait of Louis XIII.

The writer has often seen a singular transformation effected by an ingenious device, called the optical paradox: thus an eagle may be changed into a lion, and a dog into a cat.



For this purpose, a wooden three-sided box must be prepared, and through the open part may slide the various drawings to be used, as B. Connected with this, there must be a pillar, C, and a horizontal bar holding a tube, D, having in it a glass placed exactly over the centre. The change is partly dependent on the glass, the sides of which are flat and diverge from its hexagonal base upwards, to a point in the axis of the glass, like a pyramid, E, forming an isosceles triangle. All that is now necessary to the completion of the change, is in the border of the drawing, in which the various parts required for the new figure are cleverly introduced; so that when the distance of the glass from the eye is rightly adjusted, each angular side will take up its portion from the border, and present to the eye the various parts in an entire figure. The shape of the glass prevents the appearance

of any particular figure in the centre, as the eagle, for instance; while the lion, arranged in portions and drawn on the circle of refraction at six different parts of the border, yet artfully disguised by blending with it, the transformation will be completely produced.

A paper has lately been read to the Academy of Sciences at Paris, by M. Stanislaus Julien, on the metallic mirrors made in China, and to which the name of "magic mirrors" has been given. Hitherto all attempts by Europeans to obtain information as to the process, in the localities where they are manufactured, have proved failures, some of the persons applied to being unwilling to reveal the secret, and others being ignorant of the process. These mirrors are called magical, because, if they receive the rays of the sun on their polished surface, the characters, or flowers *in relief*, which exist on the other side, are faithfully reproduced. The following information has been obtained by M. Julien, from the writings of an author named Ou-tseu-hing, who lived between 1260 and 1341:—"The cause of this phenomenon is the distinct use of fine copper and rough copper. If, on the under side, there be produced, by casting in a mould, the figure of a dragon in a circle, there is then engraved deeply on the disc a dragon exactly similar. Then, the parts which have been cut are filled with rather rough copper; and this is, by the action of fire, incorporated with the other metal, which is of a finer nature. The face of the mirror is next

prepared, and a slight coating of tin is spread over it. If the polished disc of a mirror so prepared be turned towards the sun, and the image be reflected on a wall, it presents distinctly the clear portion and the dark portion, the one of the fine, and the other of the rough copper." Ou-tseu-hing states, that he had ascertained this by a careful inspection of the fragments of a broken mirror.

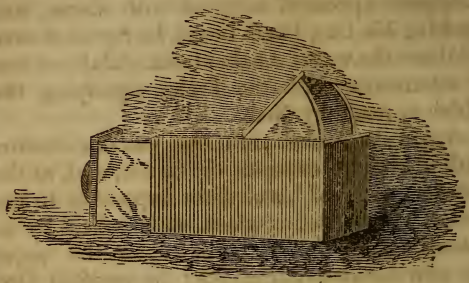
It is easy for an ignorant and superstitious mind to confound a very harmless and simple instrument with one of magical power. We have an example of this in Dodwell's description of his residence at Athens. On his first admission within the venerable walls of the Acropolis, it was necessary to offer a small present to the disdar, or Turkish governor, and an additional sum to make drawings and observations without being molested by the servants of the garrison. The disdar proved to be a man of bad faith and insatiable rapacity, and, after experiencing numerous vexations from the mercenary Turk, Dodwell was at length released from his importunities by a singular circumstance. As he was one day engaged in drawing the Parthenon, with the aid of his camera obscura, the disdar, whose surprise was excited by the novelty of the sight, asked, with a sort of fretful inquietude, what new conjuration he was performing with that extraordinary machine. Dodwell endeavoured to explain it, by putting in a clean sheet of paper, and making him look at the instru-

ment; but he no sooner saw the Temple of Minerva reflected on the paper in all its lines and colours, than he imagined the effect was produced by some magical process; his astonishment appeared mingled with alarm, and, stroking his long black beard, he repeated several times the words Allah, Masch-Allah—a term of admiration with the Turks, signifying that which is made by God.

Again he looked into the camera obscura, with a kind of cautious diffidence, and, at that moment, some of his soldiers happening to pass before the reflecting-glass, were beheld by the astonished disdar walking upon the paper. He now became outrageous; he assailed Dodwell with various opprobrious epithets, one of which was Bonaparte—the appellation being at the time synonymous to that of magician, or of any one supposed to be endowed with supernatural talents—and declared that, if Dodwell chose, he might take away all the stones in the temple, but that he would not permit his soldiers to be conjured into a box. "When I found," says Dodwell, "that it was no use to reason with his ignorance, I changed my tone, and told him that, if he did not leave me unmolested, I would put him into my box; and that he should find it a very difficult matter to get out again. His alarm was now visible; he immediately retired, and ever after stared at me with a mixture of apprehension and amazement. When he saw me come to the Acropolis, he carefully avoided my approach;

and never afterwards gave me any further molestation."

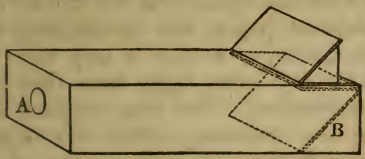
The portable camera obscura, represented by the diagram, has often yielded much plea-



sure in the domestic circle, while the larger ones, which are publicly exhibited, are highly interesting. No person, perhaps, has witnessed the neatness of outline, the precision of form, the truth of colouring, and the sweet gradations of tint, thus apparent, without regretting that an imagery so exquisite and faithful to nature could not be made to fix itself permanently on the tablet of the machine. Yet, in the estimation of all, such a wish seemed destined to take its place among other dreams of beautiful things; the splendid but impracticable conceptions in which men of science and ardent temperament have sometimes indulged. Such a dream, however, has been realized of late.

Mr. Thomas Wedgewood, the celebrated porcelain manufacturer, so early as 1802, published, in the journals of the Royal Institution,

a method of copying paintings upon glass, and of making profiles by the agency of light upon nitrate of silver. The experiments he made were repeated by sir Humphry Davy; but several years after, MM. Niepcé and Daguerre, and Mr. Fox Talbot, laid the foundation of the present state of photographic drawing. The former engaged in a long series of experiments to render metallic surfaces peculiarly sensitive; the aim of the latter was to produce this effect on paper. The camera obscura used for this purpose is a rectangular box, with



a double convex lens, A, at one end, and a glass reflector, B, which is generally a piece of looking-glass, at the other. Now, supposing the rays of light to proceed from an extensive landscape, and pass through this small convex lens, as we well know they may do, what will be the effect produced? The scene will, in the first place, be thrown on the reflector, which is fixed at an angle of forty-five degrees to the horizon. Now it follows, from a law well known to opticians, that these rays will be reflected to the top of the box, immediately over the mirror; so that if a ground glass, or any other medium capable of receiving the

reflected image, be placed there, a representation of the landscape may be observed. As then, it is proved, by innumerable experiments, that reflected light has, in proportion to its power, as much influence on prepared or photographic paper, as the direct rays of the sun; it follows that, if a piece of it be placed in the same situation as the ground glass, the reflected image, be it a landscape, a figure, or an artificial object, will be formed on it. All that is, therefore, required to be done, in using the camera obscura for photographic drawing, is to place upon the opening at the top of the box the prepared paper, and immediately to cover it with the lid, c, so that it may not be acted upon by any other light than that reflected from the mirror. The time required for producing the necessary effect will depend on several circumstances, such as the preparation of the paper and the intensity of the light when the experiment is made; the latter, however, is by far the more important. On a bright sun-shining day, the drawing will be produced in one-half the time, and with far more sharpness of outline, than on a dull wintry day, when the sun struggles with the mists by which its radiant beams are encumbered. "The Pencil of Nature," is the expressive title of a collection of photographic drawings, produced by Mr. Talbot. Upon the third part of this work, we find the following acute criticism in the *Athenæum*, No. 920.

"The subjects are 'The Entrance Gateway of

Queen's College, Oxford;' 'The Ladder,' in which we have three figures from the life; and 'A View of the Author's Residence, Lacock Abbey, in Wiltshire.' In the first of these, the truth-telling character of photographic pictures is pleasingly shown. It appears, by the turret clock, that the view was taken a little after two, when the sun was shining obliquely upon the building. The story of every stone is told, and the crumbling of its surface under the action of atmospheric influences is distinctly marked. The figures in 'The Ladder' are prettily arranged, but the face of the boy is distorted, from the circumstance of its being so very near the edge of the field of view embraced by the lens of the camera obscura. In looking at this photograph, we are led at once to reflect on the truth to nature observed by Rembrandt, in the disposition of his lights and shadows. We have no violent contrasts; even the highest lights and the deepest shadows seem to melt into each other, and the middle tints are but the harmonizing gradations. Without the aid of colour, with simple brown and white, so charming a result is produced, that, looking at the picture from a little distance, we are almost led to fancy that the introduction of colour would add nothing to its charm."

The following is the patent process for obtaining a negative picture:—Take a sheet of paper, with a smooth surface, and a close and even texture, and without the water-mark, and

wash one side of it, by means of a soft camel's-hair brush, with a solution composed of one hundred grains of crystallized nitrate of silver dissolved in six ounces of distilled water, having previously marked with a cross the side which is to be washed. When the paper has been dried cautiously at the fire, or spontaneously in the dark, immerse it for a few minutes (two minutes, at a temperature of sixty-five degrees,) in a solution of iodide of potassium, consisting of five hundred grains to one pint of distilled water. The paper is then to be dipped in water, and then dried, by applying blotting-paper to it lightly, and afterwards exposing it to the heat of a fire, or allowing it to dry spontaneously. The paper thus prepared is called iodized paper, and may be kept for any length of time in a portfolio not exposed to light. When a sheet of paper is required for use, wash it with the following solution, which we shall call No. 1; take one hundred grains of nitrate of silver, dissolved in two ounces of distilled water, and add to this one-third of its volume of strong acetic acid. Make another solution, No. 2, by dissolving crystallized gallic acid in cold distilled water, and then mix the two solutions together in equal proportions, and in no greater quantity than is required for immediate use, as it will not keep long without spoiling. This mixture, called gallo-nitrate of silver, by the patentee, is then to be spread, by a soft camel's-hair brush, on the marked side of the iodized paper;

and, after allowing the paper to remain half-a-minute to absorb the solution, it should be dipped in distilled water and dried lightly; first with blotting-paper, and then by holding the paper at a considerable distance from the fire. When dry, the paper is ready, and it is advisable to use it within a few hours.

The paper, which is highly sensitive to light, must now be placed in the camera obscura, in order to receive on its marked surface a distinct image of the landscape or person whose picture is required. After remaining in the camera from ten seconds to several minutes, according to the intensity of the light, it is taken out of the camera in a dark room. If the object has been strongly illuminated, or if the paper has been long in the camera, a sensible picture will be seen on the paper; but, if the time of exposure has been short, or the illumination feeble, the paper will "appear entirely blank." An invisible image, however, is impressed on the paper, and may be rendered apparent by the following process:— Take some of the gallo-nitrate of silver, and, with a soft camel's-hair brush, wash the paper all over with this liquid, then hold it before a gentle fire, and, in a short time, the image will begin to appear; and those parts upon which the light has acted most strongly will become brown or black, while the others remain white. The image continues to grow more and more distinct for some time, and, when it becomes sufficiently so, the operation must be terminated,

and the picture fixed. In order to effect this, the paper must be dipped first into water, then partly dried by blotting-paper, and afterwards washed with a solution of bromide of potassium, consisting of one hundred grains of the salt, dissolved in eight or ten ounces of water. The picture is then finally washed in water and dried as before. In place of bromide of potassium, a strong solution of common salt may be used.

By this process we get a negative picture—having the lights dark and the shades light—and from it positive pictures may be obtained as follows:—Dip a sheet of good paper in a solution of common salt, consisting of one part of a saturated solution, to eight parts of water, and dry it first with blotting-paper, and then spontaneously. Mark one of its sides, and wash that side with a solution of nitrate of silver, which we shall call No. 3, consisting of eighty grains of salt, to one ounce of distilled water. When this paper is dry, place it with its marked side uppermost on a flat board or surface of any kind, and above it put the negative picture, which should be pressed against the nitrated or positive paper by means of a glass plate and screws. In the course of ten or fifteen minutes of a bright sunshine, or of several hours of common daylight, a fine positive picture will be found on the paper beneath the negative picture. When this picture has been well washed or soaked in water, it is washed over with the solution of bromide of potassium, already

mentioned, or plunged in a strong solution of common salt.*

A singular result of the application of this invention occurred to an accomplished traveller, who ascended Mount Etna, in order to obtain representations of that remarkable volcano. No sooner was the camera fixed on the edge of the crater, and the sensitive paper introduced, than a partial irruption took place, and the traveller had to fly for his life. On the cessation of the irruption, he returned; doubtless, with the expectation of merely collecting the fragments of his valuable instrument; when, to his great astonishment and delight, he discovered not only that his camera was absolutely uninjured, but that it contained an admirable representation of the crater and the irruption.

A brief account of the process of the Daguerreotype may now be given. A plate of silvered copper, about as thick as a shilling, is well cleaned and polished by rubbing it with cotton, fine pumice powder, and dilute nitric acid, and afterwards exposed to the heat of a spirit-lamp, placed below it, till a strong white coating is formed on the polished surface. On the plate being cooled suddenly by means of a cold slab of stone or of metal, the white coating is removed by repeatedly polishing it with dry pumice and cotton, and then three times more with the dilute nitric acid and pumice powder.

A careful cleaning being thus given to the plate, it is placed in a box containing iodine, till

* North British Review.

it becomes visibly covered with a golden film of that substance, which must neither be pale nor purple. It is then placed in the camera till a distinct picture of whatever appears before it is formed upon the surface; it remains there for a period depending on the intensity of the light, and is then removed to a metallic box, having in it a cup containing at least three ounces of mercury. Placed below the cup is a spirit-lamp, which throws off the mercurial vapour; and, in exact proportion as this vapour deposits itself on the parts of the plate which have been acted upon by the light, is the picture developed on the surface of the plate, by the adhesion of the white mercurial vapour to the different parts which had been impressed by the light. As soon as the picture appears complete, the plate is placed in a trough of sheet-copper, containing either a saturated solution of common salt, or a weak solution of hyposulphite of soda. Thus, the coating of iodine will be dissolved, the yellow colour quite disappearing; hot, but not boiling, distilled water is then poured over the plate, and any drops which remain are removed by blowing upon them.

The picture being now finished, is preserved from dust by placing it in a frame, and covering it with glass. In every successful operation, the picture is almost as perfect in its details as that of the camera obscura itself; but, as the light of the sun is only white, there can be, of course, none of the varied tints of nature. The

shades are supplied by the black polish of the metallic surface which, when it reflects a luminous object, the white vapour of the mercury appears in shade, and thus gives us either a positive or a negative picture, according to the light in which it is viewed.

Various improvements have gradually been made in the processes of the Daguerreotype and the Talbotype, which our limited space forbids us to describe. Mr. Beard has added colour to his Daguerreotype portraits, which is uniform and so transparent as not to affect the likeness in any degree, while the life-like effect is greatly heightened. M. Claudet has found that, when the sun is rendered red by the vapours of the atmosphere, it not only produces no effect upon the Daguerreotype plate, but that it destroys the effect previously produced by the white light. If the image of the red sun be taken in the camera obscura, it produces upon the Daguerreotype plate a black image. By covering a Daguerreotype plate previously affected by light with a red, orange, or yellow glass, the radiation through these coloured media has also the property of destroying the action produced by white light. The most interesting part of M. Claudet's statement refers to the fact that, after the destroying action of the red, orange, and yellow radiations, the plate is restored to its former sensitiveness; so that, after having been affected by white light, and restored by the destructive action of the red, orange, and yellow radiations, it is possible to produce a photogra-

phic effect, as upon a plate just prepared with iodine and bromine. This alternate acting and destroying action may be repeated *ad infinitum*, without altering the final state of the plate. This curious fact proves, evidently, that, in the Daguerreotype process, light does not alter the chemical compound on the plate, and that the affinity for mercury is the result of some new property imparted by the action of the rays of light. M. Claudet's experiments prove, also, that the red and yellow rays are endowed with a photographic action of their own, which, as well as that of the blue and violet rays, gives an affinity for mercurial vapour. The photographic action of the red ray is destroyed by the yellow, that of the yellow by the red; the red and yellow destroy the photographic action of the blue, and the blue destroys the action of the others. The photographic, or the destroying action of any particular ray cannot be continued by any other. It appears, therefore, that each radiation changes the state of the plate, and each change produces the sensitiveness to mercurial vapour when it does not exist, and destroys this sensitiveness when it does exist.*

M. Regnault has laid before the Academy of Sciences, at Paris, some photographic specimens on paper, obtained by M. Blanquart-Evrard, by a modification of the usual process. In the preparations hitherto described, one part of the process presented serious difficulties, namely, that of the use of gallic acid in order to produce

* Literary Gazette.

the impression. It happened frequently, that a proof taken in too mild a light, or of too large dimensions, could not receive the necessary force before disappearing, as it may be said, under the uniform colour produced by the mixture of the gallic acid with the aceto-azotate of silver, with which the paper is imbued. After having ascertained that the gallic acid produces this uniform colour on the impression, only because it is combined in small quantity with the aceto-azotate of silver, M. Blanquart-Evrard removes all the difficulty. After taking the proof from the camera obscura, he plunges it into a vessel of large dimensions, covered with a layer of one centimètre of gallic acid of cold saturation. The bath is agitated during the immersion; and the action may be thus prolonged until the impression has obtained the necessary force to secure a good result. The proof is then washed, and the gallic acid is replaced by a solution of bromure of potassium, or chloruret of sodium, in which it is left for about a quarter-of-an-hour.*

The chromatype, discovered by Mr. Hunt, consists in washing good letter-paper with the following solution:—

Bi-chromate of potash . . .	10 grains
Sulphate of copper	20 grains
Distilled water	1 ounce

Papers prepared with this are of a pale yellow colour; they may be kept for any length of time without injury, and are always ready for

* Athenæum.

use. For copying botanical specimens or engravings, nothing can be more beautiful. After the paper has been exposed to the influence of sunshine, with the objects to be copied superposed, it is washed over in the dark with a solution of nitrate of silver of moderate strength. As soon as this is done, a very vivid positive picture makes its appearance; and all the fixing these photographic pictures require is, well washing in pure water.

M. Niepcé de St. Victor finds that, if a sheet of paper on which there is writing, printed characters, or a drawing, be exposed for a few minutes to the vapour of iodine, and there be applied immediately afterwards a coating of starch, moistened by slightly acidulated water, a faithful tracing of the writing, printing, or drawing, will be obtained. M. Niepcé has also discovered that a great number of substances, such as nitric acid, chlorurets of lime and mercury, act in a similar manner; and that various vapours, particularly those of ammonia, have the effect of vivifying the images which are obtained by photography.

In the words of a writer in the *North British Review*:—"While the artist is thus supplied with every material for his creative genius, the public will derive a new and immediate advantage from the productions of the solar pencil. The home-faring man—whom fate or duty chains to his birth-place, or imprisons in his fatherland—will, without the fatigues and dangers of travel, scan the beauties and wonders

of the globe; not in the fantastic or deceitful images of a hurried pencil, but, in the very picture which would have been painted on his own retina, were he magically transported to the scene. The gigantic outline of the Himalaya and the Andes will stand self-depicted upon his borrowed retina—the Niagara will pour out before him, in panoramic grandeur, her mighty cataract of waters, while the flaming volcano will toss into the air her clouds of dust and her blazing fragments. The scene will change, and there will rise before him Egypt's colossal pyramids, the temples of Greece and Rome, and the gilded mosques and towering minarets of eastern magnificence. But with not less wonder, and with a more eager and affectionate gaze, will he survey those hallowed scenes which faith has consecrated and love endeared. Painted in its cheerless tints, Mount Zion will stand before him, 'as a field that is ploughed;' Tyre, as a rock on which the fishermen dry their nets; Gaza, in her prophetic 'baldness;' Lebanon, with her cedars prostrate among 'the howling firs;' Nineveh made as a grave, 'and seen only in the turf that covers it;' and Babylon the great, the golden city, with its impregnable walls, its hundred gates of brass, now 'sitting in the dust, cast up as an heap,' covered with 'pools of water,' and without even the 'Arab's tent,' or the 'shepherd's fold.' But though it is only Palestine in desolation that a modern sun can delineate, yet the seas which bore on their breast the Divine Re-

deemer, and the everlasting hills which bounded his view, stand unchanged by time and the elements, and, delineated on the faithful tablet, still appeal to us with an immortal interest. But the scenes which are thus presented to us by the photographer have not merely the interest of being truthful representations: they form, as it were, a record of every visible event that takes place while the picture is delineating. The dial-plate of the clock tells the hour and minute when it was drawn, and with the day of the month, which we know, and the sun's altitude, which the shadows on the picture often supply, we may find the very latitude of the place which is represented. All stationary life stands self-delineated on the photograph:—the wind, if it blows, will exhibit its disturbing influence; the rain, if it falls, will glisten on the house-top; the still clouds will exhibit their ever-changing forms; and even the lightning's flash will imprint its fire-streak on the sensitive tablet."

CHAPTER VII.

Heat, the cause of many wonders—Its universal diffusion and application—Story of a burning-glass—The Augustine friars and the Jesuits—Impostures as to the endurance of heat—Burning mirrors—The blow-pipe—The Giants' Causeway—Application of currents of heated air—Travelling by steam.

HEAT is everywhere present: every body that exists contains it in quantity to which we can assign no limits. The endless variety of forms which are spread over and beautify the surface of the globe, are to be traced to its influence. Without it, the land and the water would fall into one formless and impenetrable mass, and the air now essential to life, prove absolutely poisonous. We shall find in connexion with it, therefore, many extraordinary phenomena.

When Labat the Jesuit visited the Peruvians, he took the naked arm of one of them, and, concentrating on it the rays of the sun by means of a powerful lens, soon made him cry out with pain, while the others looked on with wonder, not unmixed with indignation. How could this effect be produced? was instantly the question; and, as promptly, the cause was declared to be infernal. In vain did Labat assert that it was merely natural. The Peru-

vians made many attempts to obtain possession of the lens in order to destroy it, and deliver themselves from the power of that which they regarded as able to bring upon them the vengeance of the gods.

Much surprise has sometimes been awakened by an apparent insensibility to intense heat. An instance of this occurred when a rivalry existed between the Augustine friars and the Jesuits. The father-general of the Augustine friars was dining with the Jesuits; and, when the table was removed, he entered into a formal discourse of the superiority of the monastic order, and charged the Jesuits with assuming the title of "*fratres*," while they held not the three vows which other monks were obliged to consider sacred and binding. The general of the Augustine friars was very eloquent and very authoritative—and the superior of the Jesuits was very unlearned.

The Jesuit avoided entering the lists of controversy with the Augustine friar, but arrested his triumph by asking him if he would see one of his friars, who pretended to be nothing more than a Jesuit, and one of the Augustine friars who religiously performed the three vows, show instantly which of them would be readier to obey his superior?

The Augustine friar consented. The Jesuit then turning to one of his brothers, the friar Mark, who was waiting upon them, said, "Brother Mark, our companions are cold; I command you, in virtue of the holy obedience

you have sworn to me, to bring here, instantly, out of the kitchen-fire, and in your hands, some burning coals, that they may warm themselves over your hands." Father Mark instantly obeyed; and, to the astonishment of the Augustine friar, brought in his hands a supply of red burning coals, and held them to whoever chose to warm himself; and, at the command of his superior, returned them to the kitchen hearth. The general of the Augustine friars, with the rest of his brotherhood, stood amazed; he looked wistfully on one of his monks, as if he wished to command him to do the like. But the Augustine monk, who perfectly understood him, and saw this was not a time to hesitate, observed, "Reverend father, forbear, and do not command me to tempt God: I am ready to fetch you fire in a chaffing-dish, but not in my bare hands." The triumph of the Jesuits was complete, and it is not necessary to add, that "the *miracle*" was noised about, and that the Augustine friars could never account for it, notwithstanding their strict performance of the three vows! And yet here was no mystery. According to sir James Mackintosh, "In the *Mercure de France*, there is a very curious account of experiments made at Naples to discover the means by which jugglers have appeared to be incombustible. They seem to be completely discovered, and chiefly to consist in, first, gradually habituating the skin, the mouth, throat, and stomach, to great degrees of heat; second, in rubbing the skin with hard

soap, and in covering the tongue with hard soap, and over that with a layer of powdered sugar. By these means, the professor at Naples is enabled to walk over burning coals, to take into his mouth boiling oil, and to wash his hands in melted lead. The miracles of several saints, the numerous escapes from the fiery ordeal, and tricks now played by the Hindoo jugglers, are thus perfectly explained; and all these prodigies may be performed in a fortnight by any apothecary's apprentice."

Other instances of endurance are merely pretended. In country places, a conjurer sometimes appears in the streets, professing that he is able to eat fire; and yet he only rolls together a ball of flax or hemp, lights it, rolls round it some more of the same material, slips it cunningly into his mouth, and breathes through it to revive the flame; and so long as he inspires the air through the nostrils, and not through the mouth, he suffers no injury. A performer, named Richardson, in the seventeenth century, pretended to pour melted lead upon his tongue; but it is probable that he used the fusible metal formed of bismuth, tin, and lead, which melts at a low temperature, and which the writer has seen fused on a card, and poured into the hand with impunity by a person accustomed to handle hot substances.

Not many years ago, a man named Chaubert professed to be incombustible; but it has been proved that the human body is capable of bearing a very high degree of heat. Men of

unquestionable integrity have surpassed all his wonders. Sir Charles Blagden exposed himself in a heated room where the heat was one or two degrees above 260°, and remained eight minutes in this situation. Eggs and a beef-steak were placed on a tin frame, near the thermometer, and in the space of twenty minutes the eggs were roasted quite hard, and in forty-seven minutes the steak was not only dressed, but almost dry. Another beef-steak, similarly placed, was rather over-done in thirty-three minutes. Chantrey, the celebrated sculptor, accompanied by five or six friends, also entered a furnace, and, after remaining two minutes, brought out a thermometer which stood at 320°. Some pain was experienced in this experiment, but it placed beyond all doubt that the human body has a remarkable power of enduring heat. Chaubert excited much wonder by taking phosphorus into his mouth; but, as that substance, when deprived of air, will not burn, he always closed his lips, and retired to eject the phosphorus immediately afterwards.

We turn now from the resistance of heat by chemical means, to some striking examples of its power.

The name of the Giants' Causeway arose, probably, from an idea of the supernatural power, entertained in times of ignorance and superstition. And yet it is demonstrated that vast masses of rock are to be traced to causes strictly natural. Basalt is of very frequent

occurrence on the surface of the globe, and is frequently detected in a variety of volcanoes, both extinct and active. The greatest mass of basalt hitherto observed is that in the Deccan, which constitutes the surface of many thousand square miles of that part of India. In other instances, it occurs in horizontal tabular masses, and is columnar. Sometimes, the basaltic columns are curved, and of this there is a beautiful example in the island of Staffa. Now basalt is not a crystalline substance, for as it is not capable, as all crystals are, of cleavage in the line of its planes, or at some angle with them, it is concretional. Its structure resembles an onion, or any bulbous root, for, in the centre, is a solid mass, about which are others just like the parts of the vegetable products already mentioned. These portions of basalt are at first of an oval form, and then they gradually become rudely hexagonal. Some non-columnar basalts show no trace of any particular arrangement of parts, while others have a globular structure, so that when the rock becomes much decomposed, it has the appearance of numerous bomb-shells and cannon-balls cemented together.

Here, then, we have an extraordinary effect of heat. Mr. Gregory Watt took seven hundred weight of the substance named rowley rag, kept it in fusion more than six hours, and cooled it so gradually, that eight days elapsed before it was taken from the furnace. The shape of the mass was uneven and while the

thinner portion was, in consequence of more rapid cooling, vitreous, the thicker was stony; the one state passing into the other. Numerous spheroids were also formed, some being two inches in diameter. They were radiated with distinct fibres, the latter also forming concentric coats, when circumstances were favourable to such an arrangement. When the temperature had been sufficiently continued, the centres of the spheroids became compacted before they had attained the diameter of half-an-inch. When two spheroids came into contact, no penetration ensued; but the two bodies became mutually compressed and separated by a plane, well defined, and invested with a rusty colour. When several met, they formed prisms. In reasoning on these facts, Mr. G. Watt observes: "In a stratum composed of an indefinite number in superficial extent, but only one in height, of impenetrable spheroids, if their peripheries should come in contact in the same plane, it seems obvious that their mutual action would form them into hexagons; and if these were resisted below, and there was no opposing cause above them, it seems equally clear that they would extend their dimensions upwards, and thus form hexagonal prisms, whose length might be indefinitely greater than their diameters."

That the great power in operation in the formation of basaltic columns is heat, appears to be indisputable. There is, for example, a bed of sandstone in furnaces for smelting

metals, and, in the course of time, it requires to be repaired. Portions, taken out, on such occasions, have been found to have a columnar appearance: the heat of the furnace having changed the form of the substance, not by any fusion of its parts, but by a peculiar arrangement of them, thus giving them the specified figure.

Another astonishing result of this natural power is seen in the eruption of a volcano. The eye of a traveller, perhaps, as it is turned towards Vesuvius, discerns a dark red spot on the mountain's side, issuing from an orifice near to the crater. But soon, that deep burning light apparently spreads out, or flows on into a long wide stream, descends the entire length of the great cone, and reaches to the plain below. But, as the first light was seen through and behind the mists which follow the departure of the sun, so now its extended influence is only rendered visible by the increasing gloom. But, as the eye is still attracted towards this remarkable eminence, a pillar of fire is seen rising up from the crater high into the air; while innumerable lights appear, like so many natural fire-works rushing upwards, and falling in a glowing shower, on the outer sides of the crater, which soon present the aspect of a heap of fire. Large and red-hot stones are flung forth from time to time, from the same troubled source, to fall, roll down the sides of the crater, and lose their brightness.

Mountains that are liable to volcanic action,

before an eruption takes place, are generally the most fertile, and the most attractive of all eminences. Illustrations of this remark are found upon a magnificent scale in Mexico; and, among the rest, that of Jorullo, in the extensive intendency of Valladolid, lying on the west coast of America, between the intendencies of Mexico and Guadalaxara, (pronounced Quadalahàra.) Mechoacan, a part of it, is an expanse of table-land which enjoys a fine and temperate climate, and is intersected with hills and charming valleys, presenting an appearance unusual in the torrid zone, of extensive and well-watered meadows. On the twenty-ninth of September, 1759, from the centre of a thousand burning cones was thrown up the volcano of Jorullo; a mountain of scoriæ and ashes, seventeen hundred feet high, in an extensive plain, and covered with most luxuriant vegetation. When plains, hills, and valleys, are thus spoken of, the reader should remember, that all of them are reared upon the lofty chain of the Andes, for volcanic eruptions only, so far as we know, take place in mountainous regions.

But some of the most remarkable examples are to be met with in the Spice Islands, or Moluccas. The pointed and conical mountains, which characterize this group of islands, exhibit great fertility. Nothing can surpass the richness of vegetation with which their sides are covered, nor the balmy healthfulness of the breezes that encircle round them, to temper the heats of the sultry zone. But the nature of

these mountains is closely connected with volcanic action; so that, in fearful apprehension, we might look at each one of these beautiful peaks, as if it were destined one day to be torn from its station and thrown into the sea.

"I will stretch out mine hand upon thee, and roll thee down from the rocks, and will make thee a burnt mountain," was one of the Divine denunciations against Babylon, Jer. li. 25. Judgment has not thus fallen on Ternate, one of the most lovely of the cluster just adverted to; but the top of the highest rock has been torn off, and hurled from a height of five or six thousand feet, into the sea. A huge gap was left behind, which seemed to a traveller when standing on the edge, like a deep valley, or ravine, betwixt two mountains. As the portion rent away in this tremendous struggle was split into fragments of various sizes, there is, besides, a vast pile at the water's edge, a road, or causeway, strewed with half-vitrified pieces of rock and cinders, from the margin of the rift to the declivity of the mountain; so that the island, so lovely under other aspects, presents on this side a fearful scene of desolation. What a striking comment on the words, "I will make thee a burnt mountain;"—I will tear off thy summit, shiver it into ten thousand pieces, and therewith overwhelm and destroy the natural verdure of thy sides, which once looked so goodly and so fair! Some time in March, 1839, another eruption took place at Ternate; so that, long before these ejected

matters could yield to the decomposing action of the atmosphere, and afford a soil for vegetable growth, another layer, of equally forlorn and broken kind, was scattered over them.

In connexion with these astounding phenomena, it may be remarked that an apparatus has recently been contrived called the fire-annihilator, the origin of which is not a little curious. It is said that the inventor observed that the smoke hovering over a burning mountain diminished its fury, and that, on analysing it and combining similar elements, he discovered the means of extinguishing fires, and thus of arresting at the outset what might otherwise prove a tremendous calamity.

Many processes of art, like the operations of nature, are dependent on heat. By this agent, the most obdurate masses soften like wax, and yield to the forms which are demanded by our wants and our tastes; and compounds, knit together by stubborn affinities, are resolved by it into their original elements. The baron Von Tchivanhausen constructed a burning mirror in 1687, five feet three inches in breadth, and reflecting the solar rays with extraordinary power. When exposed to its force, wood took fire, and continued to burn, notwithstanding a most violent wind; and water, contained in an earthen vessel, quickly boiled, so that eggs were cooked, and the liquid soon after evaporated. Copper and silver were fused in a few minutes, and slate was transformed into a kind of black glass, which, when held by a pair of

pincers, could be drawn out into filaments. This mirror afterwards came into the possession of the king of France, and was kept in the Jardins du Roi. Other mirrors have been formed of different substances. At the Polytechnic Institution, some years ago, there were two metallic discs placed at the extreme ends of the great hall, and when a vessel of burning coals was held in the focus of one, and a piece of meat in the focus of the other, the latter was cooked with marvellous rapidity by a simple and apparently an unimportant instrument.

The blow-pipe has immense power. Two volumes of hydrogen, and one of oxygen gas, when pure, form a mixture which produces in this instrument intense heat, and most substances may be fused by the flame. In the experiments of Dr. E. Clarke, lime, strontion, and alumine, yielded to its powers. The alkalis were fused and volatilized almost the instant they came into contact with the flame: and rock crystal became a transparent glass full of bubbles. Opal changed into a pearly white enamel, and flint into one that was frothy. Blue sapphire was melted; and Peruvian enamel changed into a transparent and colourless glass. Lapis lazuli fused into transparent glass, with a slight tinge of green. Iceland spar, next in difficulty, as to fusion, to its native magnesia, melted at last into a limpid glass, giving out an amethyst-coloured flame. Diamond first became opaque, and was then gradually volatilized. Gold, mixed with borax as a flux, was fused; pla-

tina wire melted the instant it was brought into contact with the flame, and ran down in drops; brass wire burned with a green flame; and iron wire with brilliant sparks.

At a recent meeting of the British Association, Dr. Faraday exhibited some diamonds, which he had received from M. Dumas, which had, by the action of intense heat, been converted into coke. In one case, the heat of the flame of oxide of carbon and oxygen had been used; in another, the oxyhydrogen flame; and, in the third, the galvanic arc of flame from a Bunsen battery of one hundred pairs. In the last case, the diamond was perfectly converted into a piece of coke; and, in the others, the fusion and carbonaceous formation were evident. Specimens in which the character of graphite was taken by the diamond were also shown. The electrical characters of these diamonds were stated also to have been changed, the diamond being an insulator, while coke is a conductor.

A rope, nearly three miles long, was recently lying on the verge of the borough of Gateshead, which was shortly before a stone in the bowels of the earth. Smelted, the stone yielded iron. The iron was converted into wire. The wire was brought to the wire-rope manufactory of Messrs. R. S. Newall and Co., at the Teams, near Gateshead, and there twisted into a line 4,660 yards long. It was supposed to be the stoutest rope of the kind that was ever made. It weighs twenty tons, five hundredweights, and

cost the purchasers upwards of £1,134. It was intended for the incline on the Edinburgh and Glasgow Railway, near the latter city. A rope of hemp of equal strength would weigh thirty-three tons and-a-half, and cost about three hundred pounds more. It would also entail greater expense while in operation, (owing to its greater weight,) and would sooner wear out.

"The process," says the *Pharmaceutical Journal*, "for purifying and agglomerating caoutchouc, preparatory to its being cut into sheets, and also for effecting the latter operation, are due to the ingenuity of M. Sievier. The general principle is this:—Pieces of caoutchouc, mixed, as they are in their native state, with various impurities, are put into a strong metallic drum, through which passes an axle, studded with chisel-shaped teeth. The interior of the drum is supplied with similar ones, but stationary. Therefore, when the axle is made to revolve, the caoutchouc becomes subjected to a most powerful rending and kneading motion, in the course of which sufficient heat is evolved, notwithstanding a current of cold water continually passes through the drum, to agglutinate the material into a compact mass. This mass is now subjected to the pressure of a powerful screw apparatus, and made to assume the form of a cuboid, from which sheets of caoutchouc may be eventually cut by the rapid vibratory action of a knife, kept moistened with water. As solvents for

caoutchouc, equal parts of coal naptha and turpentine are commonly used; and, of late, the bisulphuret of carbon has been much employed."

Mr. J. Wishaw has lately shown the advantages arising from the application of currents of heated air to the following purposes: seasoning timber, generally; preserving timber, purifying feathers, blankets, clothing, etc.; drying coffee, roasting coffee, japanning leather for table-covers, and other purposes; drying silks, drying yarn, drying distillers' tuns, drying papier-mâché, and drying vulcanized india-rubber. The process has also been successfully tested for drying loaf-sugar, drying printing-paper, or setting the ink, to enable books to be bound more quickly than usual; drying starch, and converting it into dextine, or British gum; and preserving meat. It has been also stated, that sixty suits of clothes, which had belonged to persons who had died of the plague in Syria, had been subject to the process of purification, at a temperature of about 240°, and afterwards worn by sixty persons; not one of whom ever gave the slightest symptom of being affected by the malady. In describing these processes, the writer referred to the mode adopted by the North American Indians for preserving the meat of the buffalo—that of drying it in the sun; and stated that heated currents had been applied successfully. The discovery seems highly important for shipping; as, instead of sailors

consuming salted provisions from one month's end to another, they might thus have an occasional supply of fresh meat. Meat treated in this way occupies much less space, too, and is much lighter in weight. It is believed that the juices of the meat contain about seven-eighths of watery moisture: this, the current of heated air removes, leaving the albumen and all the flavour and nutrition behind.

That in the production of steam heat is of incalculable value, there needs no proof. We derive special advantage from it, in the results of that machinery which astonish us by their magnitude, as well as by their elegance. Steam wafts us, in a few hours, from one extremity of the land to the other, and renders America, once called the New World, accessible in a few days.

Another instance of its application, often overlooked, is thus stated in the *Quarterly Review:*—"That extraordinary line of steam communication between England and her eastern possessions, (somewhat oddly called the *overland* journey,) of which Australia and New Zealand will hereafter form the extreme branches. The creation of the last twelve years, this communication has already acquired a sort of maturity of speed and exactness, notwithstanding the enormous distances traversed, and the changes necessary in transit from sea to sea. The Anglo-Indian mail in its two sections, and including passengers and correspondence, possesses a sort of individuality as

the greatest and most singular line of intercourse on the globe. Two of the first nations of Europe, France and Austria, struggle for the privilege of carrying this mail across their territories. Traversing the length of the Mediterranean, it is received on the waters of the ancient Nile—Cairo and the Pyramids are passed in its onward course—the desert is traversed with a speed which mocks the old cavalcades of camels and loitering Arabs—it is re-embarked on the Red Sea, near a spot sacred in scriptural history—the promontory projecting from the heights of Mount Sinai, the shores of Mecca and Medina are passed in its rapid course down this great gulf—it emerges through the straits of Babelmandel into the Indian seas—to be distributed thence by different lines to all the great centres of Indian government and commerce, as well as to our more remote dependencies in the straits of Malacca and the Chinese seas. There is a certain majesty in the simple outline of a route like this, traversing the most ancient seats of empire, and what we are taught to regard as among the earliest abodes of man—and now ministering to the connexion of England with that great sovereignty she has conquered, or created, in the east; more wonderful, with one exception, than any of the empires of antiquity; and, perchance, also, more important to the general destinies of mankind."

CHAPTER VIII.

The magic swan—Properties of the magnet—The mariner's compass—The process of magnetizing—The dip of the needle—Magnetic properties in various substances.

A MAGICIAN of former days had a figure of a swan, which floated on a vessel of water, round the rim of which were placed the twenty-four letters of the alphabet. Addressing the spectators, he was accustomed to ask for a name to be given him, and it was correctly spelt by the swan, as it moved from one letter to another till it had indicated the whole. A little philosophy, in this instance, produced repeatedly great astonishment. A magnetic bar was placed in the swan, and the performer had a powerful magnet concealed in his own dress, and the swan, of course, followed his motions. Thus, if he wanted the swan to spell "Selina," he moved first to S, then to E, and so on, through the successive letters of that name, till the word was spelt. On one occasion, however, the performer was not a little disconcerted—the swan stopped in its course and refused to move. Again and again the effort was made, but it was utterly in vain; the magician could only

acknowledge that some person was in the room aware of his secret, and counteracting his movements. Sir Francis Blake Delaval avowed himself to be the person: he produced a magnet which he had used on facing the performer as he stood at the table; the swan was, therefore, placed between two attractive instruments, and, of course, remained immovable.

A magnet may be described as a piece of iron, which possesses the property of turning towards the poles of the earth. This extraordinary quality does not necessarily belong to all specimens of iron in its native state, but only to one kind or variety called the oxide, on account of its union with oxygen in a particular condition. The possession of a special quality in this ore of iron was not discovered from its polarity, or power of turning to the poles of the earth, but from its property of attracting small pieces of iron, which are not magnetic; and hence it was called the loadstone.

There are many uses to which the magnet has been applied, and there is a probability of its being much more extensively employed; but its most important application is in the construction of the mariners' compass, which renders it possible freely to traverse the ocean. There has been some controversy as to the discovery of the directive power of the magnet, and the invention of the compass. It was once supposed to have been unknown until about the thirteenth century, but it is now generally acknowledged that the Chinese were acquainted

with the compass at least eleven hundred and fourteen years before the birth of Christ. At the commencement of the thirteenth century, it was certainly in use in Europe; for cardinal de Vitty mentions it with some particularity, in a work entitled "The History of the East," where he says, "The iron needle, after contact with the loadstone, constantly turns to the north star, which, as the axis of the firmament, remains immovable, while the others revolve; and hence it is essentially necessary to those navigating on the ocean." This shows that the compass was not invented in Europe, as commonly believed, by Gioia, a pilot, and a native of Pasitano, a small village, situated near Amalfi, who lived about the end of the thirteenth century, but, by him, it appears to have been made fully available for the purposes of navigation.

As used by sailors in the Mediterranean at that period, it was a very uncertain guide; for the compass then consisted of a magnetic needle attached to two straws on a piece of cork, floating on water in a basin, or glass vase. Gioia, therefore, placed the magnetic needle upon a pivot, so that it was free to move in any direction, and thus prevented that inconvenience and inaccuracy of observation which must have resulted from the motion of the needle floating on water, agitated by the tossing of the vessel. The magnetic needle was afterwards attached to a card divided into thirty-two points, called the *rose des vents*, so that the direction in which a

vessel was sailing could be minutely determined, and the means of ascertaining it was no longer dependent on the accuracy of the eye in measuring distances. The mariners' compass is still constructed in the same manner, but is inclosed in a box with a glass cover, and is thus preserved from the influence of the wind. Another improvement has been made in so suspending the box that, however the vessel may be pitched by the waves, and rolled from side to side, the needle remains in a horizontal position, and gives accurate indications of the direction in which the vessel is sailing.

In addition to the properties already mentioned, the loadstone has the power of communicating its virtues to any piece of hard iron or steel, and that, without diminution of strength; so that, if but one piece had been discovered, it would have been sufficient for the production of all the magnets that have ever been formed by man. Other means may be adopted of accomplishing this purpose. Take a bar of iron, and, striking it several times with a hammer, it will become magnetic. This experiment may be performed with a common poker. The magnetism thus communicated to a steel bar will be much increased in power, if it be supported on another bar during the process of hammering.

Gay Lussac, a French chemist of great celebrity, discovered a method of making magnets by a process so simple, that it may, in all cases, be applied successfully. Take a piece of

thin iron wire and suspend it in a vertical position. The earth itself being a magnet, induces a magnetic power in the wire. To render this permanent, twist the wire till it breaks, and a magnet will be obtained.

Mrs. Somerville, well known for her excellent philosophical works, made some experiments on the effect of solar light in the production of permanent magnetism. If half of a small sewing needle be covered with paper, and the exposed part be placed in the violet or indigo ray, magnetism will be induced, and the same effect will be produced in a smaller degree by the blue and green.

To describe but one more mode; magnets are readily made by what is called the single touch, and this is perhaps the most simple and most effective way of proceeding. Place the steel bar to be magnetized on a table, or any other convenient place, and, as nearly as possible, north and south, which position is called by philosophers, the magnetic meridian. This being done, draw over it perpendicularly a strong magnet. In this operation, it is necessary to begin at one end of the bar, and draw the magnet over its entire length, and then again in the same direction. It must not be drawn backward and forward, for the power communicated in one direction, would be destroyed by an opposite motion.

The following experiments are very instructive:—Suspend a magnetic needle by a silk cord, so that it will hang in a horizontal position.

Then bring it over the centre of a large magnet lying upon a table, and it will still retain its position; but, as it is brought near to either end, it will be bent downwards, and, at the extremities, will be vertical. This experiment illustrates what is called the dip of the magnet. On the equator of the earth, the needle is horizontal, or nearly so, but as it is brought near the poles it dips, and over either magnetic pole would be vertical. The reason of this is evident from the former experiment: at the equator, each pole of the needle is attracted in an equal degree by the north and south poles of the earth; but, if we proceed northward, the north pole of the magnet will be more attracted than the south, and point towards it until at last it becomes vertical. The poles of the earth's rotation, that is, the points which would form the terminations of its axis, did it revolve on one, are not the magnetic poles; nor is the equator of the earth the magnetic equator. They do not, however, greatly vary.

Take, also, a bar magnet, and, placing it upon a table, cover it with a sheet of writing-paper. Then sprinkle upon it some fine iron filings, and they will arrange themselves in very beautiful curves round the magnet, showing, as it is supposed, the circulation of the magnetic fluid. From this experiment, we learn that the magnetic power is greatest at the poles: and this is true in reference to the magnetism of the earth, which increases in power from the

magnetic equator to the magnetic poles of the earth, as determined by a great variety of interesting and delicate experiments. Sir Graves C. Haughton has communicated a paper to the June number of Brewster's *Philosophical Magazine*, entitled "Experiments proving the common nature of Magnetism, Cohesion, Adhesion, and Viscosity."

This paper contains two separate sets of experiments, the first of which relates to the attraction the magnetic needle has for various mineral, vegetable, and animal substances : and it is not a little remarkable that antimony and bismuth, as well as copper, tin, and cadmium, are, in these experiments, shown to have attractive powers for the magnetic needle; though, in those made by Dr. Faraday, he has ranged them amongst the class of dia-magnetics, that is, of those that exhibited repulsion. Arsenic, too, which he found so intractable, was made, in the present experiments, to assume the real magnetic character, that is to say, the power of attracting and repelling, by being kept for a short time in contact with a bar magnet. Iodine, likewise, was found, on bringing it near the needle, to be able to attract it.

In most of these experiments, the needle was made to attach itself to the substances by being forced towards them by a magnet, which was gently withdrawn after contact was so effected. In this way, and by a reference to the degrees of the compass traversed by the needle, a hair of the head, or a spark of diamond, can be

accurately measured. The strength of the needle in its movement on a pivot was ascertained by azimuths, of which a detailed account is given.

The remainder of the memoir, which is contained in a supplementary number of the Magazine, is devoted to a detail of about five hundred experiments, in which non-ferruginous needles were made, by a modification of the magnetic needle, of which they formed a portion, to attach themselves to the same substances as in the preceding experiments. Thus, for instance, needles of most of the remarkable metals, as well as of glass, were found to have a strong affinity for nearly every kind of substance, whether mineral, vegetable, or animal, if its density was greater than that of cork or charcoal. Brass surpassed all the metals in its power of attraction, and, what is most remarkable, the magnetic needle was the lowest of all in the scale, showing not much more than one-third of the attractive energy of soft iron. Every substance of a crystalline or vitreous character exhibited remarkable magnetic properties, and this could not be mistaken, as it might be heightened at pleasure by contact with either pole of a powerful magnet. Towards the close of the experiments, the curious discovery was made, that needles of ivory, mother-of-pearl, tortoise-shell, horn, etc., were singularly magnetic, and this is traced to the albumen and gelatine they contained; and the inference is drawn, from this and other facts, that the

cohesive, adhesive, and viscous properties of bodies are owing to real magnetic qualities, and that, by drying, albuminous, gelatinous, and glutinous fluids constitute various kinds of glass, which view is supported by what takes place with the gelatinous hydrate of silicium.

"The preceding experiments," says the writer, "include a vast variety of substances in the mineral, vegetable, and animal kingdoms, that exhibit such strong attractive affinities for one another, that, however much they may differ in their external appearances, and in their very natures, they are bound together by common bonds that connect them all into a single family; for we find the metal attaching itself to crystalline, animal, and vegetable substances; and, again, the crystal, whether we call it by the name of diamond, salt, or sugar-candy, connecting itself readily to metallic, animal, and vegetable bodies. In a similar way, animal bodies attach themselves to those that are mineral and vegetable; and, to complete the circle, the vegetable kingdom, by its woods, its gums, its lac, and its resins, is connected with them all."

CHAPTER IX.

The electrical kite—Candles magically lighted—St. Elmo's fire—The chronoscope—The electric clock—The electric telegraph—Sub-marine telegraphs—The overruling providence of God.

In the auto-biographical memoirs of sir John Barrow, lately published, he says, when describing some of the employments of his youth: "I had fallen in with an account of Benjamin Franklin's electrical kite, and a kite being a very common object with school-boys, and a string steeped in salt-water with a glass-handle to it not difficult to be had, I speedily flew my kite, and obtained abundance of sparks (like those obtained from an electrical machine.) An old woman, curious to see what I was about, was too tempting an opportunity not to give her a shock, which so frightened her, that she spread abroad in the village that I was no better than I should be, for that I was drawing down fire from heaven. The alarm ran through the village, and my poor mother entreated me to lay aside my kite."

It was recently announced by a professor of magic, that several hundred candles would be lighted by one pistol-shot. Accordingly, the

stage appeared in partial darkness, but, through the gloom, ranges of candles might be indistinctly perceived at different heights from the floor; and, in a minute or two, the performer was seen to enter and discharge a pistol, when all the candles were instantly ignited, and the array of magical instruments appeared strongly illuminated, ready to be employed in the subsequent exploits—an effect always followed by enthusiastic acclamations. And yet there is no difficulty in explaining this prodigy. Candles, carefully prepared to ignite readily, might have above them an arrangement of wires, with the point of a wire just over each wick, and the whole being connected with an electrical battery, they could be ignited instantly, at a moment's notice. The instant of the performer's entering, might be the signal for the discharge of the battery by others, and the report of the pistol would prevent any sound being heard on the removal of the wires, which the previous darkness had effectually concealed.

Lord Napier says, that when he was in the Mediterranean, some years ago, and during an awful thunderstorm, he was retiring to rest, when he heard suddenly a cry, from those aloft, of "St. Elmo and St. Anne!" which induced him again to go on deck. On observing the appearance of the masts, the maintop-gallant mast-head was completely enveloped in a blaze of pale phosphoric light; the other mast-heads presented a similar appearance; the flame pre

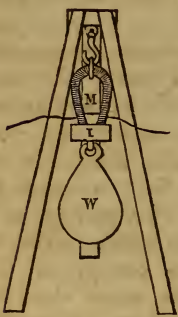
serving its intensity for eight or ten minutes, and then gradually becoming fainter. Yet this appearance, which superstition declared to be miraculous, was only electrical; for, while the solar heat is converting into vapour the water and moisture of the earth, electricity is freely disengaged. "The clouds which this power forms are in different electrical conditions, though the electricity of the atmosphere, when serene, is invariably the same. Hence the descent of clouds towards the earth, their mutual approach, the force of atmospherical currents, and the ever-varying agencies of heat and cold convert the aërial envelope of the globe into a complete electrical apparatus; spontaneously exhibiting, in a variety of forms, the play of the conflict of its antagonist powers. At the close of a sultry day, and above level plains, the opposite electricities of the earth and the air effect their re-union in noiseless flashes of lightning, illuminating, as it were, in far-spread sheets, the whole circuit of the horizon, and the entire canopy of the clouds. At other times, the same elements light up the arctic constellations with their restless wildfires—now diffusing their phosphoric flame, and flitting around in fitful gleams, and now shooting up their auroral columns, advancing, retreating, and contending, as if in mimicry of mortal strife."*

That electricity and magnetism are identical, is evident from many experiments. If a sewing-

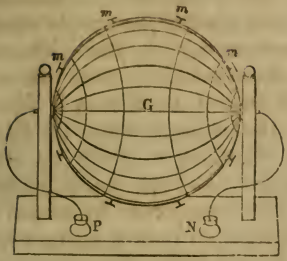
* Edinburgh Review.

needle be placed in a wire, twisted in that form called a helix, and a shock of electricity be then passed through it, from a Leyden jar, the needle will be magnetized. The form of the wire, and the manner of placing the needle, are shown in the figure.

Again, if M be a piece of soft iron, of a horse-shoe shape, and surrounded with copper-wire covered with a non-conducting substance, it will become powerfully magnetic on connecting the ends of the wire with a galvanic battery. If this be only of a moderate size, and a keeper, I, be attached to M, it will suspend W, representing a very heavy weight.



Mr. Barlow has so arranged a globe, as to identify the dip of the needle with electricity, a current of which appears to be always passing round the earth. At G, in the opposite diagram, is a globe having a wire covered with silk, coiled entirely over it, from one pole, round and round to the other. The ends of this wire dip into two cups, P and N, connected with the poles of a galvanic battery. When the current passes from this, the



small and delicately balanced magnets, *m*, will show polarity, and dip, just the same as in the earth itself.

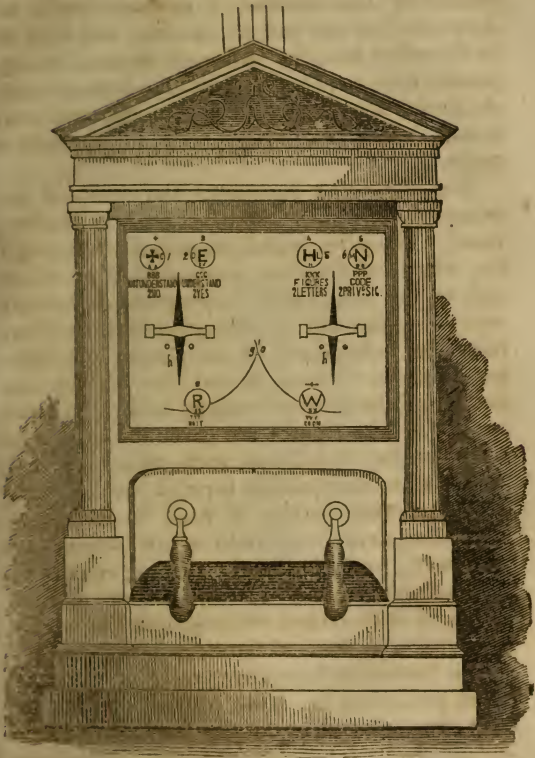
Mr. Bain's electric clock is a remarkable contrivance. Nothing can be more satisfactory or complete. Allowing for wear and tear of materials from friction, and the oxidating influence of the atmosphere, the perpetual motion appears to be realized. As long as the electricity of the earth continues, or, in other words, as long as the laws of nature last, so long will Mr. Bain's clock continue its oscillations, and register the transit of time. The pendulum conducts, and is the treasury of that power, and two simple wheels and their attachments, with the dead escapement, complete the machine. By an ingenious provision, Mr. Bain's electric clock at the manufactory extinguishes the gas-light which illuminates its dial, at half-past twelve precisely.

Mr. Bain has invented and patented another kind of electric clock, the clock being in Glas-

gow, and the pendulum in Edinburgh. By means of the electric telegraph along the railway, constructed by Mr. Bain, he intimated his wish that the pendulum at the other end of the line should be put in motion. The clock was placed in the station-house in Glasgow, the pendulum belonging to it in the station-house at Edinburgh, the two being forty-six miles apart. They were joined by means of the wire of the telegraph, in such a manner as that, by a current of electricity, the machinery of the clock in Glasgow was made to move correctly, according to the vibrations of the electrical pendulum in Edinburgh. Thus, in like manner, were England and Scotland united in one great chronometrical alliance, a single electrical pendulum of this description, placed in the Observatory at Greenwich, would give the astronomical time correctly throughout the country.

The electric telegraph may be said to have originated in a trivial incident. It occurred to professor Oersted, of Copenhagen, to try the effect of a galvanic current on the needle of the compass. He found it, on making the experiment, deflected, that is, turned aside from its usual bearing of due north and south. Professor Wheatstone applied this result very ingeniously. He arranged a series of needles, mounted like that of the compass, and found that he could turn any of these aside by galvanic currents, while the others remained at rest. It was evident, therefore, that if each

needle were supposed to denote a letter, any letters might thus be indicated; and, conse-



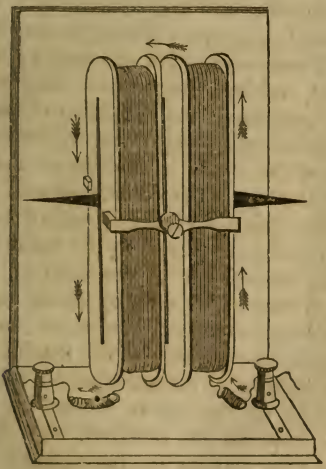
quently, if an arrangement of needles standing for so many letters, respectively, were placed at

the distance of fifty or a hundred miles, and any of them were acted on by means of wires traversing the distance, a message could be despatched at one end of the line, and read off at the other from the deflected needles, by any person duly acquainted with the arrangement. A similar set of needles at the opposite end, would enable him, as certainly, to transmit a reply.

The engraving represents the front of the telegraph, exhibiting the index, as it is denominated. The wires, which are suspended through the length of the line, are attached at either end to the telegraphic instruments, a branch wire being fastened to a large metallic surface, imbedded in the earth for completing the electric current. When at rest, the handles are down, and the pointers remain in their vertical position. The signals are given by two magnetic needles, or pointers, each suspended vertically on an axis passing through the dial, and, behind, another pointer is fixed on each corresponding axis. A portion of the conducting wire, many yards in length, is coiled round the galvanometer frame, in which the magnet moves, so as to subject the magnet to the multiplied deflecting force of the electric current.

The battery is the motive power of the machine, occupying the same relative position to it, as the boiler does to the locomotive; for, though it does not produce any immediate result on the works, yet the part it performs in the undertaking is essential. While travelling,

Mr. Cooke found great inconvenience to result from the spilling of the acid solution used in Smee's batteries; and, from this, he was led to consider if the substitution of fine white Shanklin sand, saturated with the diluted acid, would not avoid this difficulty. Experiments having confirmed the truth of his conjecture, the change was permanently arranged, and it was subsequently found so advantageous, that



the same method was tried in the permanent batteries, and, in like manner, the result has proved satisfactory. At present, the generator resembles, in its principal features, the one

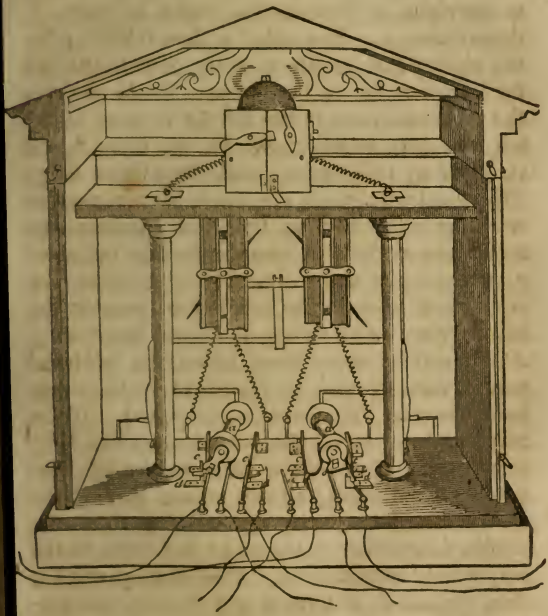
known as Wollaston's trough; and it is so arranged, that the series of plates of copper and amalgamated zinc, arranged for the evolution of the electric fluid, admit of being placed in a corresponding series of cells, filled with well-washed and dry sand. The *United Service Gazette* states, that all that is necessary in order to use the instrument is, slightly to moisten the sand with diluted sulphuric acid.

The conducting wires are, at their ends, of less diameter, and are so arranged as to form the coiled magnets. Those in the diagram are seen in connexion with the works; the electric current, taking the course indicated by the arrows, occasions the deflection of the needle.

The following engraving represents the interior of the machine, and shows the means by which the magnet is connected with the electric current. The parts lettered *a* are the key-shafts, which, on being turned to the right or left by a handle, pushes one of the springs, *c*, from its point of contact, *d*, and, by changing the course of the electric current, produces a corresponding change in the position of the needle.

In making a communication to the person stationed at the point where he wishes the information to be received, the operator, by turning the handle to the right or left, breaks the electric current; then, pressing the wire against pins connected with the battery-poles, the coils of wire receive their full deflective force, and attract the magnetic needles to either side, according to the course of the current.

Thus, if the stream of electricity passes into the coil on the right, the upper part of the needle will be attracted towards it; if the stream passes into the coil on the left, then the needle will, in like manner, be attracted to it; thus, giving the



whole motion necessary to the pointers. The time which elapses between the moving of the

handles and the effect on the pointers, is imperceptible, though we must believe that it really follows it. The dial is divided into five circles, each containing a number of letters, or signs. The left-hand needle moving to the left twice, gives *a;* three times, *b;* once to the right and once to the left, *c;* once to the left and once to the right, *d;* once to the right, *e;* twice, *f;* three times, *g.* The order is then taken up by the right-hand needle moving once to the left for *h;* twice for *i;* three times for *k;* once to the right and once to the left for *l;* once to the left, and once to the right, for *m;* once to the right for *n;* twice for *o;* and three times for *p.* The remaining signs are made by two needles working conjointly, so that the simultaneous movement of the *two,* once to the left, indicates *r;* twice for *s;* three times for *t;* once to the right, and once to the left, for *u;* once to the right for *w;* twice for *x;* and three times for *y.* At the end of every word given, the left-hand needle, moving once to the right, to the cross, indicates that the word is completed. If the receiver understands the word, he signifies it by moving the same pointer twice to the left, and twice to the right, which means *yes;* if the communication is not understood, then the needle points twice to the right, and twice to the left, which indicates *no.* The original word is then repeated; if figures are wanted, the motions for each letter are doubled. Previously to giving a signal, the attention of the operator is called by the ringing of a bell, which is

accomplished by an apparatus as simple as it is ingenious.*

That communications by this means may often be of great importance, is evident, from many newspaper paragraphs. The following appeared in the early part of 1847: "On Friday evening the following message was received at the Chesterfield station: 'Tell Derby, a Mr. H. has escaped from the York Asylum, and is supposed to have fire-arms about his person. Search all the trains from York. He is tall, has a crooked nose, and has a green coat with pockets at the side. Tell the police to look out.' To this message another succeeded from Leeds: 'He is caught at Leeds; they have him quite secure.' "

An establishment has lately been opened near the Bank of England, in which telegraphic intelligence may be despatched, or received, in all the principal towns of our country. The difficulties which have existed in reference to sub-marine telegraphs appear to have been overcome; for the time occupied from the commencement of carrying the telegraph across Portsmouth harbour, and transmitting signals, does not occupy a quarter-of-an-hour. The telegraph, which has the appearance of an ordinary rope, is coiled into one of the dockyard boats, one end of it being made fast on shore; and, as the boat is pulled across, the telegraphic

* For a fuller account of the electric telegraph, see "The Visitor," for January, February, and March, 1848; from which many facts, now given, have been taken.

rope is gradually paid out over the stern, its superior gravity causing it to sink to the bottom immediately. The telegraph consists of but this line; and, unlike those along the various railways, requires no return wires to perfect the circuit. The electric fluid is transmitted from the batteries in the dockyard, through the submersed insulated wire to the opposite shore; the fluid returning to the negative pole through the water without the aid of any metallic conductor, except a short piece of wire thrown over the dockyard parapet into the water, and connecting it with the batteries. The fact of the water acting as a ready return conductor, is established beyond question. In 1842, Mr. Snow Harris, when proving the efficiency of his lightning-conductors in his experiments from this dockyard to the Orestes, exemplified that water would serve to complete the electric circuit. On that occasion, the distance traversed by the return current through the water was but trifling compared with the space accomplished in the present instance. The batteries used are Smee's; and a very delicate and accurate galvanic detector, invented by Mr. Hay, the chemical lecturer of the dockyard, has also been brought into requisition. Independent of the simplicity of this sub-marine telegraph, it has an advantage which even the telegraphs on land do not possess—in the event of accident, it can be replaced in ten minutes.

At the last meeting of the British Association,

the chairman, sir R. H. Inglis, thus adverted to the progress of the electric telegraph, from a report presented to the Legislative Council and Assembly of New Brunswick, relative to a project for constructing a railway, and with it a line of electro-magnetic telegraph, from Halifax to Quebec:—

"The system is daily extending. It was, however, in the United States of America that it was first adopted on a great scale, by professor Morse, in 1844; and it is there that it is now already developed most extensively. Lines for above thirteen hundred miles are in action, and connect those states with Her Majesty's Canadian provinces; and it is in a course of development so rapid that, in the words of the report of Mr. Wilkinson to my distinguished friend, his excellency sir W. E. Colebrook, the governor of New Brunswick, 'no schedule of telegraphic lines can now be relied upon for a month in succession, as hundreds of miles may be added in that space of time. So easy an attainment does such a result appear to be, and so lively is the interest felt in its accomplishment, that it is scarcely doubtful that the whole of the populous parts of the United States will, within two or three years, be covered with a net-work, like a spider's web, suspending its principal threads upon important points, along the sea-board of the Atlantic on one side, and upon similar points along the lake frontier on the other.' I am indebted to the same report for another fact, which I think the association

will regard with equal interest:—'The confidence in the efficiency of telegraphic communication has now become so established, that the most important commercial transactions daily transpire, by its means, between correspondents several hundred miles apart. Ocular evidence of this was afforded me by a communication a few minutes old between a merchant in Toronto, and his correspondent in New York, distant about six hundred and thirty-two miles.' I am anxious to call your attention to the advantages which other classes also may experience from this mode of communication, as I find it in the same report:—'When the Hibernia steamer arrived in Boston, in January, 1847, with the news of the scarcity in Great Britain, Ireland, and other parts of Europe, and with heavy orders for agricultural produce, the farmers in the interior of the states of New York, informed of the state of things by the magnetic telegraph, were thronging the streets of Albany with innumerable team-loads of grain, almost as quickly after the arrival of the steamer at Boston, as the news of that arrival could ordinarily have reached them. I may add that, irrespectively of all its advantages to the general community, the system appears to give already a fair return of interest to the individuals or companies who have invested their capital in its application.'"

Professor Morse states, as the result of improvements in this telegraph, the president's message, entire, on the subject of the war with

Mexico, was transmitted with perfect accuracy at the rate of ninety-nine letters per minute. His skilful operators in Washington and Baltimore printed these characters at the rate of ninety-eight, one hundred-and-one, one hundred-and-eleven, and one of them actually printed one hundred-and-seventeen per minute. He must be an expert penman who can write legibly more than one hundred letters per minute; consequently, this mode of communication equals, or nearly equals, the most expeditious mode of recording thought!

Here, then, we close our series of illustrations of what is popularly termed "Natural Magic," but, strictly speaking, of natural laws; having glanced at the arrangements of mechanical skill, terrestrial phenomena, chemical wonders, and the effects of light, heat, and electricity.

In doing so, we are reminded of the words of the psalmist:—"Thy faithfulness is unto all generations: thou hast established the earth, and it abideth. They continue this day according to thine ordinances: for all are thy servants," Psa. cxix. 90, 91.

The constancy of nature, thus so clearly indicated, is illustrated by ordinary experience. The child who flies his kite in the air, or places his little ship on the surface of the stream, or gathers together the dry leaves to make a blaze, yea, even by the food that he eats, and by his movements in his daily walks, proves that nature has laws, and that in them there is continuance. In after-life, the fact is still more

obvious. Every day and every night bear their explicit testimony to it. Water finds its way to the ocean by a thousand channels; it is raised to the higher regions of the atmosphere to be dispersed in light and fleecy clouds over the four quarters of the globe; and, at length, accomplishes its circuit, by fallin in showers on the dry and thirsty ground.

"It needs, however," says Chalmers, "the aid of philosophy to learn how unvarying nature is in all her processes—how even her seeming anomalies can be traced to a law that is inflexible—for what might appear at first to be the caprices of her waywardness, are, in fact, the evolutions of a mechanism that never changes—and that, the more thoroughly she is sifted and put to the test by the interrogations of the curious, the more certainly will they find that she walks by a rule which knows no abatement; and perseveres with obedient foot-step in that even course, from which the eye of strictest scrutiny has never yet detected one hair's-breadth of deviation. It is no longer doubted by men of science, that every remaining semblance of irregularity in the universe is due, not to the fickleness of nature, but to the ignorance of man—that her most hidden movements are conducted with a uniformity as rigorous as fate—that even the fitful agitations of the weather have their law and principle—that the intensity of every breeze, and the number of drops in every shower, and the formation of every cloud, and all the occurring

alternations of storm and sunshine, and the endless shiftings of temperature, and those tremulous varieties of the air which our instruments have enabled us to discover, but have not enabled us to explain—that still, they follow each other by a method of succession, which, though greatly more intricate, is yet as absolute in itself as the order of the seasons, or the mathematical courses of astronomy. This is the impression of every philosophical mind with regard to nature, and it is strengthened by each new accession that is made to science. The more we are acquainted with her, the more are we led to recognise her constancy, and to view her as a mighty, though complicated machine, all whose results are sure, and all whose workings are invariable!"

Who is not filled with amazement in contemplating the power of the Almighty? Only let it be his will to set one of his agents loose, and the earth and all that it contains shall be burned up. Well may we tremble at the thought of that "wrath which is revealed from heaven against all ungodliness and unrighteousness of men!" On those who believe not, the curse of Jehovah abides. Would that men considered how fearful a thing it is to fall into the hands of the living God! Convinced by the Holy Spirit of their guilt and danger, they would then fly to the only hope set before them in the gospel.

"In vain we seek for peace with God
By methods of our own:
Jesus, there's nothing but thy blood
Can bring us near the throne.

The threatenings of thy broken law
Impress our souls with dread;
If God his sword of vengeance draw,
It strikes our spirits dead.

But thine illustrious Sacrifice
Hath answered these demands;
And peace, and pardon, from the skies,
Came down by Jesus' hands."

It has been well remarked by Bacon, that "it is heaven on earth to live in charity, to turn upon the poles of truth, and to rest in Providence." The tenderness and minuteness of the Divine care are taught us by our Lord himself: "Fear not them which kill the body, but are not able to kill the soul: but rather fear him which is able to destroy both soul and body in hell. Are not two sparrows sold for a farthing? and one of them shall not fall on the ground without your Father. But the very hairs of your head are all numbered. Fear ye not therefore, ye are of more value than many sparrows," Matt. x. 28—31.

Let, then, all who are reconciled to God through the death of his Son, be comforted by this truth. God is not far from every one of us; the vast and the minute are alike under his control; and he has graciously promised that all things shall "work together for good to them that love God, to them who are the called according to his purpose."

In the ignorance and superstition of the human mind, applications are sometimes made to those who are supposed to be endowed with magical powers. Such practices are condemned in the Scriptures as vain and wicked. Hence,

says the prophet Isaiah, "When they shall say unto you, Seek unto them that have familiar spirits, and unto wizards that peep, and that mutter: should not a people seek unto their God? for the living to the dead? To the law and to the testimony: if they speak not according to this word, it is because there is no light in them," Isa. viii. 19, 20.

CHAPTER X.

Claims of the church of Rome to miraculous power—The Franciscans and Dominicans—Tale of bishop Remi—The effect of relics—Friars' pretended dispossession of evil spirits—Tragical event—Appearance of the virgin Mary to shepherds exposed—Pretended miracle of the Greek church.

THE Romish church, in all ages, has affirmed that to it has been granted the power of working miracles. Its "Lives of the Saints," a series extended avowedly through many centuries, abound with relations of what are described as supernatural appearances, but which we can only trace to a very different cause.

The two following facts are given by Luther:—"In the monastery of Isenach stands an image, which I have seen. When a wealthy person came thither to pray to it, (it was Mary with her child,) the child turned away its face from the sinner to the mother, as if it refused to give ear to his praying, and was therefore to seek mediation and help from Mary the mother. But, if the sinner gave liberally to that monastery, then the child turned to him again; and if he promised to give more, then the child showed itself very friendly and loving, and stretched out his arms over

him, in the form of a cross. But this image was made hollow within, and prepared with locks, lines, and screws; and behind it stood a knave to move them; and so were the people mocked and deceived, taking it to be a miracle wrought by Divine Providence!"

"A Dutchman, making his confession to a mass-priest at Rome, promised, by an oath, to keep secret whatever the priest would impart to him, till he came into Germany, upon which the priest pretended to give him a leg of the ass on which Christ rode into Jerusalem, very neatly bound up in a silken cloth, and said, 'This is the holy relic on which the Lord Christ did corporeally sit, and with his sacred legs touched this ass's leg!' The Dutchman was wonderfully pleased, and carried the holy relic with him into Germany, and when he came upon the borders, boasted of his holy possession in the presence of four others of his comrades, at the same time showing it to them; but each of the four having also received a leg from the priest, and promised the same secrecy, he inquired with astonishment, 'Whether that ass had five legs!'"

The frauds practised by the professed ministers of religion, during the almost universal prevalence of popery, most affectingly display the depravity of the human heart, and the impious tendency of false religion. Never, perhaps, was a stratagem acted more infamous than one in Berne, in the year 1509, the following account of which drawn from Ruchet's

"Histoire de la Réformation en Suisse," and Höttinger's "Hist. Eccles. Helvet.," is given in Mosheim's "Eccles. Hist." A similar account may be found in bishop Burnet's Travels through France, Italy, etc. The stratagem in question was the consequence of a rivalship between the Franciscans and Dominicans, and more especially of their controversy concerning the immaculate conception of the virgin Mary. The former maintained, that she was born without the blemish of original sin; the latter asserted the contrary. The doctrine of the Franciscans, in an age of darkness and superstition, could not but be popular; and hence, the Dominicans lost ground from day to day. To support the credit of their order, they resolved, at a chapter held at Vimpsen in the year 1504, to have recourse to fictitious visions and dreams, in which the people at that time had an easy faith; and they determined to make Berne the scene of their operations. A person named Jetzer, who was extremely simple, and much inclined to austerities, and who had taken their habit as a lay-brother, was chosen as the instrument of the delusions they were contriving. One of the four Dominicans, who had undertaken the management of this plot, conveyed himself secretly into Jetzer's cell; and, about midnight, appeared to him in a horrid figure, surrounded with howling dogs, and seemed to blow fire from his nostrils, by the means of a box of combustibles which he held near his mouth. In this frightful form, he

approached Jetzer's bed, told him that he was the ghost of a Dominican, who had been killed at Paris, as a judgment from heaven for laying aside his monastic habit; that he was condemned to purgatory for this crime; adding, that, by his means, he might be rescued from his misery, which was beyond expression. This story, accompanied with horrible cries and howlings, frightened poor Jetzer out of the little wits he had, and engaged him to promise to do all in his power to deliver the Dominican from his torment. Upon this, the impostor told him, that nothing but the most extraordinary mortifications, such as the discipline of the whip, performed during eight days by the whole monastery, and Jetzer's lying prostrate, in the form of one crucified, in the chapel, during mass, could contribute to his deliverance. He added, that the performance of these mortifications would draw down upon Jetzer the peculiar protection of the blessed virgin; and concluded by saying that he should appear to him again, accompanied with two other spirits.

Morning was no sooner come, than Jetzer gave an account of this apparition to the rest of the convent, who all unanimously advised him to undergo the discipline that was enjoined; and every one consented to endure his share of the task imposed. The deluded simpleton obeyed, and was admired as a saint by the multitude that crowded about the convent, while the four friars, that managed the impos-

ture, magnified, in the most pompous manner, the miracle of this apparition, in their sermons, and in their discourse. The night after, the apparition was renewed, with the addition of two impostors, dressed like devils; and Jetzer's faith was augmented by hearing from the spectre all the secrets of his life and thoughts, which the impostors had learned from his confessor. In this, and some subsequent scenes, (the detail of whose enormities we shall here omit,) the impostor talked much to Jetzer of the Dominican order, which he said was peculiarly dear to the blessed virgin; he added, that the virgin knew herself to be conceived in original sin; that the doctors who taught the contrary were in purgatory; that the blessed virgin abhorred the Franciscans for making her equal with her Son; and that the town of Berne would be destroyed for harbouring such plagues within her walls. In one of these apparitions, Jetzer imagined that the voice of the spectre resembled that of the prior of the convent, and he was not mistaken; but, not suspecting a fraud, he gave little attention to this. The prior appeared in various forms, sometimes in that of St. Barbara, at others, in that of St. Bernard; at length, he assumed that of the virgin Mary; and, for that purpose clothed himself in the habits that were employed to adorn the statue of the virgin in the great festivals; the little images, that on these days are placed on the altars, were made use of for angels, which, being tied to a cord that

passed through a pulley over Jetzer's head, rose up and down, and danced about the pretended virgin to increase the delusion. The virgin thus equipped, addressed a long discourse to Jetzer, in which, among other things, she told him that she was conceived in original sin, though she had remained but a short time under that blemish. She gave him, as a miraculous proof of her presence, a host, or consecrated wafer, which turned from white to red in a moment: and, after various visits, in which the greatest enormities were transacted, the virgin-prior told Jetzer, that she would give him the most affecting and undoubted marks of her Son's love, by imprinting on him the five wounds that pierced Jesus on the cross, as she had done before to St. Lucia and St. Catharine. Accordingly, she took his hand by force, and struck a large nail through it, which threw the poor dupe into the greatest torment.

The next night, this masculine virgin brought, as he pretended, some of the linen in which Christ had been buried, to soften the wound, and gave Jetzer a soporific draught, which had in it the blood of an unbaptized child, some grains of incense, and of consecrated salt, some quicksilver, and the hairs of the eye-brows of a child, all of which, with some stupifying and poisonous ingredients, were mingled together by the prior with magic ceremonies, and a solemn dedication of himself to the devil in the hope of his succour. This

draught threw the poor wretch into a sort of lethargy, during which the monks imprinted on his body the other four wounds of Christ, in such a manner that he felt no pain. When he awoke, he found, to his unspeakable joy, these impressions on his body, and came at last to fancy himself a representative of Christ in the various parts of his passion. He was, in this state, exposed to the admiring multitude on the principal altar of the convent, to the great mortification of the Franciscans. The Dominicans gave him some other draughts, that threw him into convulsions, which were followed by a voice conveyed through a pipe into the mouths of two images, one of Mary, and another of the child Jesus; the former of which had tears painted upon its cheeks in a lively manner. The little Jesus asked his mother, by means of this voice, (which was that of the prior,) why she wept? and she answered, that her tears were owing to the impious manner in which the Franciscans attributed to her the honour that was due to him, in saying that she was conceived and born without sin.

The apparitions, false prodigies, and abominable stratagems of these Dominicans were repeated every night; and the matter was at length so grossly over-acted, that, simple as Jetzer was, he at last discovered it, and had almost killed the prior, who appeared to him one night in the form of the virgin, with a crown on her head. The Dominicans, fearing,

by this discovery, to lose the fruits of their imposture, thought the best method would be to own the whole matter to Jetzer, and to engage him, by the most seducing promises of opulence and glory, to carry on the cheat. Jetzer was persuaded, or at least he appeared to be so. The Dominicans, however, suspecting that he was not entirely gained over, resolved to poison him; but his constitution was so vigorous that, though they gave him poison five several times, he was not destroyed by it. One day, they sent him a loaf prepared with some spices, which, growing green in a day or two, he threw a piece of it to a wolf's whelps, that were in the monastery, and it killed them immediately. At another time, they poisoned the host, or consecrated wafer, but he escaped once more. In short, there were no means of securing him, which the most detestable impiety and barbarity could invent, that they did not put in practice; till, finding at last an opportunity of getting out of the convent, he threw himself into the hands of the magistrates, to whom he made a full discovery of this infernal plot. The affair being brought to Rome, commissaries were sent from thence to examine the matter; and the whole cheat being fully proved, the four friars were solemnly degraded from their priesthood, and were burned alive, on the last day of May, 1509. Jetzer died some time after at Constance, having poisoned himself, as was believed by some. Had his life been taken away before he had found an opportu-

nity of making the discovery already mentioned, this execrable and horrid plot, which, in many of its circumstances, was conducted with art, would probably have been handed down to posterity as a stupendous miracle.

When the Reformation was spread in Lithuania, prince Radzviil was so affected by it, that he went in person to pay the pope all possible honours. His holiness, on this occasion, presented him with a precious box of relics. The prince having returned home, some monks intreated permission to try the effect of these relics on a demoniac, who had hitherto resisted every kind of exorcism. They were brought into the church with solemn pomp, and deposited on the altar, accompanied by an innumerable crowd. After the usual conjurations, which were unsuccessful, they applied the relics. The demoniac instantly recovered. The people called out, "A miracle!" and the prince, lifting his hands and eyes to heaven, felt, it is said, his faith confirmed. In this transport of joy, he observed that a young gentleman, who was keeper of this treasure of relics, smiled, and by his motions ridiculed the miracle. The prince indignantly took the young keeper of the relics to task; who, on the promise of pardon, gave the following secret intelligence concerning them. In travelling from Rome he had lost the box of relics, and, not daring to mention it, he obtained a similar one, which he had filled with small bones of dogs and cats, and other trifles similar to what

were lost. He hoped he might be forgiven for smiling, when he found such a collection of rubbish was idolized with such pomp, and had even the virtue of expelling demons! It was by the assistance of this box that the prince discovered the gross impositions of the monks and demoniacs, and Radzviil afterwards became a zealous Lutheran.*

To take another case, for which we are indebted to Scott's "History of the Lives of Protestant Reformers in Scotland." At the east end of the village of Musselburgh there was a chapel dedicated to the virgin Mary; its proper name being Loretta, though it was vulgarly called Alareit, or Lawreit. There was also a chapel of the same name in Perth, and many credulous people of both these places, as well as the people of Loretta, in Italy, believed that their chapel contained within it the identical small brick-built house in which Mary had dwelt at Nazareth, and that it had been conveyed miraculously from its original seat. At the time now referred to, it was announced in Edinburgh, and the neighbouring places, that a miracle would be performed on a certain day, and a great number of persons consequently assembled. A stage was erected on the outside of the chapel, and, at length, a young man, apparently blind, was led forward. Many of those who were present knew this person, and had, perhaps, often pitied his circumstances. After various prayers and ceremonies, his eyes,

* D'Israeli's "Curiosities," p. 87.

to the satisfaction of the people, appeared to be perfectly restored. Returning thanks to the priests and friars, he now left the stage, and received the congratulations of the people, some of whom gave him money.

The true character of the treatment of his case will appear from the following narrative. He had been a poor friendless boy, who had attended the sheep belonging to the ruins of Scienna, or Sciennes, about a quarter of a mile from Edinburgh. It was one of his amusements to turn up the whites of his eyes; and, so effectually did he do this, as to appear, at pleasure, perfectly blind. The nuns spoke of him to some priests and friars, and they laid the plan which was afterwards carried out. The child was secreted for some years from public view, and, when it was supposed he was so altered as not to be recognised, he was sent forth a blind mendicant, accompanied by a person who believed he was born so, and had previously been supported by the nuns. Bound by a solemn but rash vow to affect blindness, he travelled the country for a considerable time, till at length the trick of his restoration was played as has already been stated.

Among the numerous publications of M. Guizot, is an edition of the "Chronicles of Frodvard," which, in addition to much historical matter, ascribes many miracles to the bishops of Rheims. One of them, bishop Remi, it is said, "was in the house of a wealthy female relative, conversing with her on religious topics, when her

butler announced that there was no more wine in the cellars. The bishop, seeing her embarrassment, having previously entered some of the lower apartments himself, proposed to accompany her to the cellar. When they entered it, he inquired whether there was not a little wine remaining in a particular cask. The butler replied, that there was only enough to preserve it from decay. The bishop then desired him to shut the door, and not to stir from his position, and passing to the other end to the cask, which was pretty large, he made the sign of the cross and prayed. Soon the wine rose up out of the cask, and flooded over the cellar-floor!" Now, the fact of the bishop's visit to the cellar first; of a butler, it might be, not very acute in vision, being desired, after locking the door, to exclude all witnesses, and to stand at a distance; and, of a relation of the bishop, who might easily be made a confederate, being engaged; is surely more than sufficient to set aside the whole tale. Moreover, the lady gave, as the result of the prodigy, which many a conjuror has easily surpassed, a portion of her estate in perpetuity to the bishop and his church! Prodigies of the Romish church in abundance have had precisely the same issue.

In an official and authorized Roman Catholic publication, printed in 1831, we are told that not less than twenty-six pictures of the virgin Mary opened and shut their eyes at Rome during the years 1796 and 1797, which

was supposed to be an indication of her peculiar favour to the inhabitants of that city for the opposition which they presented to the French. Among the subscribers to this work are the four archbishops and eleven bishops of Ireland.

"An officer in the British army described to me," says Mr. Hughes, "an extraordinary scene which he witnessed in Messina, in 1811, occasioned by a picture of the virgin, in a church much venerated by the populace. An inhabitant going in, according to custom, to offer up his adoration to the Madonna, suddenly ran out again, exclaiming, that '*the virgin was weeping* for calamity impending over the city.' The people rushed in crowds to the church; when, lo! to their astonishment and dismay, the tears were, as reported, trickling over the cheeks of their beloved patroness; upon which, the whole multitude began to weep, and howl, and beat their breasts, expecting nothing less than an earthquake, or a French invasion. At length one, more acute than the rest, observed that some water was passing through the roof of the church, and dripping upon the canvas, pointed out the circumstance; but he nearly fell a victim to his want of judgment, for the people were determined to have a miracle; nor could they be persuaded to disperse till the archbishop, a venerable old man, mounted a ladder, and wiped the lady's eyes with a napkin; after this, he drew the picture into a more perpen-

dicular situation, telling his audience, that, as the cause was luckily removed, *their patroness* had promised to weep no more."*

The author of "Rome in the Nineteenth Century" says: "Private miracles affecting individuals go on quite commonly every day without exciting the smallest attention. These generally consist in procuring prizes in the lottery, curing diseases, and casting out devils. The mode of effecting this last description of miracle was communicated to me the other day by an abate here, and, as I think it extremely curious, I shall narrate it to you.

"It seems that a certain friar had preached a sermon during Lent, upon the state of the woman mentioned in Scripture possessed with seven devils, with so much eloquence and unction, that a simple countryman who heard him went home, and became persuaded that seven devils had got possession of him. The idea haunted his mind, and subjected him to the most dreadful terrors; till, unable to bear his sufferings, he unbosomed himself to his ghostly father, and asked his counsel. The father, who had some smattering of science, bethought himself, at last, of a way to rid the honest man of his devils and his money together. He told him it would be necessary to combat with the devils singly, and, on the day appointed, when the poor man came with a sum of money—without which the good father told him the devil never could be dislodged—he bound the

* Hughes's Travels, Vol. I. p. 125.

chain connected with an electrical machine in an adjoining chamber round his body—lest, as he said, the devil should fly away with him—and, having warned him that the shock would be terrible when the devil went out of him, he left him praying devoutly before an image of the Madonna; and after some time, gave him a pretty smart shock, at which the poor wretch fell insensible on the floor from terror. As soon as he recovered, however, he protested that he had seen the devil fly away out of his mouth, breathing blue flames and sulphur, and that he felt himself greatly relieved. Seven electrical shocks at due intervals having extracted seven sums of money from him, together with the seven devils, the man was cured, and a great miracle performed!

"To us this transaction seemed a notable piece of credulous superstition on the one hand, and fraudulent knavery on the other; but to our friend the abate, it only seemed an ingenious device to cure of his fears a simpleton, over whose mind reason could have no power—as the physician cured a lady who fancied she had a nest of live earwigs in her stomach, not by arguing with her on the absurdity of such a notion, but by showing her that an earwig was killed by a single drop of oil, and making her swallow a quantity of it.

"But with respect to the man and his devils, I would ask, why inspire superstitious terrors to conquer them by deceit, and why make him pay so much money? Yet this is

nothing to other things that are of daily occurrence."

In some of the provinces of France, miracles are stated continually to be performed, and the peasants blindly adopt all the extravagances presented to their acceptance. In the little town of Fécamp there is a fountain, the water of which is said to do wonders; and thousands of pilgrims annually resort to it from the neighbouring country. The curé distributes to each a bottle of this water, accompanying it with some Latin words, receiving two sous for his trouble. This amounts to a considerable sum. In another town, Andelys, there is also a fountain which, it is said, possesses, once a year, the sovereign virtue of curing rheumatism, palsy, and nervous affections. The pilgrims either plunge the diseased member into the water, or throw themselves in entirely, and, afterwards, follow the procession in their wet clothes.

In the month of June, 1824, in a small village, called Artes, near Hostalrich, about twelve leagues from Barcelona, there was a constitutionalist, and therefore one opposed to the ruling power, with which the priesthood was fully identified. This man being at the point of death, his brother called on the curate, and requested him to come and administer the sacraments. The curate refused; affirming that the brother, as a constitutionalist, was a villain, an impious wretch, an enemy to God and man; he was lost, without mercy, and that, therefore, it was useless to confess him. The

brother asked whence this information was derived; the reply was, that God himself told the curate this during the sacrifice of the mass. In vain the brother reiterated his intreaties; the curate was inexorable. A few days after, the constitutionalist expired, and the brother demanded for the body the rites of sepulture. The curate refused, alleging that the soul of the departed was lost, and that it was in vain to inter the body; adding, "For during the night, the devils will come and carry it away; and in forty days, you yourself will meet the same fate."

The Spaniard not treating this declaration with implicit faith, but, with his suspicions awakened, watched during the night, with his pistols loaded, beside the body of his brother. Between twelve and one o'clock, a knock was heard at the door, and a voice exclaimed, "I command you to open the door, in the name of the living God! Open! if not, your instant ruin is at hand." The Spaniard refused; and shortly after he saw enter, by the window, three figures, covered with the skins of wild beasts, provided with horns, claws, and tails; and, as they were about carrying off the coffin containing the body, the Spaniard fired, and shot one of them dead; the others took to flight; he fired after them, and wounded both. One of them died in a few minutes, the other escaped. In the morning, a discovery was made: the people went to church, but there was no curate to officiate: it was found shortly

after, on examining those who had been shot, that one was the curate, the other the vicar; the person wounded was the sacristan, who confessed the whole plot. The case was brought before the tribune of Barcelona.*

And yet, despite of the frequent exposure of its wicked pretences, the Romish church contends at this hour as earnestly for the possession of miraculous endowments as it ever did. As it claims to be unchangeable, this is manifestly its only course. Accordingly, it has been affirmed of the last persons added to the Romish calendar, only a few years ago, that they wrought miracles. The time of canonization is sagaciously deferred till two centuries after the decease of the parties; but there is no difficulty in seeing that all the avowed deviations from the laws of nature attributed to the canonized, are impious pretences. Dr. Harsnett, afterwards archbishop of York, said, long since, "None but the pope and his scholars can cogge a miracle kindlie, and he and his priests can despatch a miracle as easily as a squirrel can cracke a nutte. A miracle in the bread, a miracle in the wine, a miracle in the holy water, a miracle in holy oyle, a miracle in lamps, candles, beades, bones, stones; nothing done in religion without a miracle and a vice." And even Petrarch thus wrote :—

"Fountain of grief, abode of anger,
School of errors, and temple of heresy;
Formerly Rome, now Babylon false and guilty;
Through whom there are so many tears and sighs;

* Foreign Quarterly Review.

O mistress of deceit; O prison of anger,
Where the good perish, and the bad are cherished and engendered,
Hell of the living! It will be a great miracle
If Christ is not angry with thee at last."

So recently as the beginning of the year 1847, the virgin Mary was said to have appeared to two shepherds, in the district of Grenoble. The so-called miracle was blazed forth far and wide, and an engraved representation of the appearance was widely distributed. Nor was this all: it was said that the virgin sat on a stone during the interview, and that, on this being broken, after she was gone, there was found in the interior an image of our Lord! But what are the facts that have been discovered since? That the priests employed a lady to personate the virgin; and that the figure in the stone was traced by a French officer, who, with a companion, placed it on that spot for a joke; as, in Italy, objects of modern manufacture are buried, and then dug up, to be passed off on the unwary as really antique! In such instances, however, money is frequently made; while the French officers had no mercenary intentions.

We close these exposures with a pretended miracle of the Greek church. At the church of the Holy Sepulchre at Jerusalem, there is annually a ceremony to which multitudes are attracted. It is pretended by the Greek priests, that, on a particular day, a sacred fire proceeds from the sepulchre: the pilgrims, therefore, congregated at Jerusalem, attend

there to light theirs; these are then extinguished, and carefully preserved, to be added to the garment dipped in the Jordan when they are buried. All, however, await the arrival of the Turkish governor; for, "till he arrives, the miracle is not certainly to take place."

To quote from some travellers who were present at the ceremony, during the year 1846, we are informed that "it was a very remarkable scene. The large area of the church was densely crowded; but, around the sepulchre, a space of about four feet wide was kept clear by a double line of Turkish soldiers. At short intervals of time, a number of infatuated and highly-excited men and boys entered in, and, rushed round and round with desperate energy, screaming and hallooing like so many maniacs. Some stood upright on a friend's shoulders, who ran with the rest till an unlucky stumble threw both to the ground. One old man was particularly conspicuous; he generally headed the rest, and seemed to be fitter for a strait-waistcoat than to be the leader of a religious procession. He danced, shouted, and threw himself into all sorts of postures. At last he mounted on another frantic devotee, and urged him to his utmost speed: they continued their mad course till he was thrown down violently against two of the soldiers; they seized him by the hair of his head, and hauled him out of the church. In a few minutes, however, he returned and was more outrageous than before.

Thus, for two hours, the church was a scene of noise, confusion, and frantic excitement. At two o'clock the governor arrived, and quietly took his seat. The racing pilgrims were driven off the course, and, shortly after, a procession of priests, headed by the patriarch, and followed by a motely group of ragged fellows, bearing shabby banners, walked slowly round three times, chanting some prayers. The patriarch was a grey-headed old man, with a cunning expression of countenance; his very look seemed to say, 'I am about to act a lie—what fools are you to believe it!' There is a circular hole in the side of the little chapel built over the sepulchre; close to it a man was posted, protected by the soldiers. He was a rich pilgrim, probably an Armenian, who had paid handsomely for the privilege of being the first to light his tapers by the holy fire. The old patriarch, having divested himself of most of his fine trappings, entered alone into the sanctuary. In a minute after, he pushed through the hole a quantity of flaming cotton, dipped in spirits of wine; the favoured pilgrim eagerly lighted a bunch of tapers by it, and, escorted by the soldiers, hurried out of the church. The excitement was now at its height; a scene followed which baffles description. There was a tremendous rush towards the flame, still held out by the patriarch, and each strove who should light his taper the earliest. Those who could not get up to head-quarters were obliged to procure a

light from the more fortunate, and in three minutes the church and adjoining chapels were in a blaze. Thousands of wax-candles and flambeaux were glittering over the space; some had forty or fifty long thin tapers bound together, which were intended as valuable presents for friends at home. It was, for the time, like Bedlam let loose: some were kneeling in ecstatic adoration, others screaming, dancing, and jumping; the more zealous put the flame into their mouths, or applied it to their faces or naked breasts. It is asserted that the holy fire does not burn or hurt any one, but Mr. Dalton noticed that few kept it long enough near to give it a fair trial. In ten minutes every taper was extinguished, and the pilgrims dispersed, carrying away the precious relics."*

In former parts of this volume, it has been shown that surprising effects are frequently produced for the amusement of others, or from the love of gain and celebrity, so common to fallen man. And, doubtless, wherever true piety does not operate—the piety which is displayed in supreme love to God, and pure and expansive benevolence to man—there will be some manifestation of the "spirit" that worketh in "the children of disobedience." While "he that doeth righteousness is righteous, he that committeth sin is of the devil; for the devil sinneth from the beginning," 1 John iii. 7, 8.

To transgressors of every age our Lord still says, "Ye are of your father the devil, and the

* "The Boat and the Caravan."

lusts of your father ye will do," John viii. 44. And bondage to the "god of this world" brings on his captives, whether old or young, rich or poor, instructed or untaught, not only guilt but misery; while "the end of these things is death," Rom. vi. 21.

But when we see impious pretences employed in order to hold the minds of men in the most degrading vassalage, we have a fearful display of enormous guilt, accumulated by a wilful subjection to "the father of lies." Satan was "a liar from the beginning." To accomplish his purposes, he can "transform himself into an angel of light;" and still he leads multitudes "captive at his will." Marvellous is the forbearance of the Supreme Governor of the universe, who does not at once ease him of his adversaries, but still richly and freely offers the blessings of salvation to a world which lieth in the wicked one. Who will not desire that the goodness of God may lead the greatest transgressors to repentance? And, as one act of submission to the prince of the power of the air is a fearful step towards an absolute and eternal thraldom, it becomes each of us to imitate those who could say, "We are not ignorant of his devices;" constantly to present at the throne of grace the petition, "Lead us not into temptation, but deliver us from evil;" and to trust implicitly in Him who, on the cross having "spoiled principalities and powers, made a show of them openly, triumphing over them in it," 2 Cor. ii. 11; Matt. vi. 13; Col. ii. 15.

CHAPTER XI.

Real Miracles—A miracle defined by archbishop Tillotson—The miracles of Moses—The miracles of our Lord Jesus Christ—The miracles of the apostles—Collision with those who pretended to supernatural power—The magicians of Egypt—Magical arts at Ephesus—The miraculous power of the Saviour inherent, that of the prophets and apostles derived—Cessation of miraculous gifts.

We now enter on a brief consideration of unquestionable miracles. As the grant of Divine revelation was made to some persons who were to proclaim it to the whole human race, so, while holy men of God spake as they were moved by the Holy Ghost, the broad seal of Heaven was placed by miracles on their testimony. As a man's signature gives validity to his bond, or the credentials of an ambassador demonstrate his right to transact the business of his sovereign; so the supernatural works performed by the prophets, by our Lord Jesus Christ, and by his apostles, prove as fully to those who witnessed them, that the words they heard proceeded from God, as if they had listened to him pronouncing them with an audible voice from the excellent glory; while all to whom their testimony has been faithfully transmitted, may cherish an equal confidence.

It has been well remarked by archbishop Tillotson, that "there are two things necessary in a miracle: that there should be a supernatural effect, and that this effect should be evident to sense." He adds, "Neither in Scripture, nor in profane authors, nor in common use, is anything called a miracle but what falls under the cognizance of the senses; a miracle being nothing else but a supernatural effect evident to sense, the great end and design whereof is to be the sensible proof and conviction of something that we do not see." The church of Rome affirms that, in the celebration of the mass, the bread and wine are changed into the very body and blood, soul and Divinity, of our Lord Jesus Christ; though they retain exactly the same appearance that they had before the change is said to have occurred. Hence, the same writer argues, "For want of a supernatural effect evident to sense, transubstantiation is no miracle; a sign or a miracle is always a thing sensible, otherwise it could be no sign. Now, that such a change in transubstantiation should really be wrought, and yet that there should be no sign of it, is a thing very wonderful; but not to sense, for our senses perceive no change. And that a thing should remain to all appearance just as it was, hath nothing at all wonderful in it. We wonder, indeed, when we see a strange thing done, but no man wonders when he sees nothing done."

Numberless were the miracles wrought by Jehovah in ancient times, in behalf of his chosen

people. In vain does infidelity object that the contents of the books of Moses *may* not be true; since, had they been false, it was absolutely impossible that they could have obtained any credit. The number of the people must have amounted to three millions, and every adult person was a competent judge whether the things related to have taken place within his own memory had really happened.

The Israelites would not have believed that the Red Sea was divided to give them a passage—that, during their pilgrimage of forty years in the wilderness, a miraculous cloud had guided them by day, and become at night a fire casting round its radiance—that they had been supplied with manna from heaven, falling on six successive days around their camp, and on the last of them a double quantity, to prevent its being gathered on the sabbath—that God had published his law on the mount that might not be touched, amidst thunders, and lightning, and tempest—and that he had punished its violation by terrible plagues—for them to believe these things would have been absolutely impossible, had the whole narrative been a fiction. A romance would have excited their ridicule, and the yoke which, on the ground of the invention, was to be placed about their necks, would have been rejected with the utmost indignation. It is also morally impossible that the books of Moses could have been received in the age immediately after his death, if their contents had been false; and highly improbable that, though true, they

would have been considered his writings, if they had been set forth by some other person in his name, and had not appeared till he was lying in his grave.

It would be easy to show that the wondrous acts recorded are traced explicitly to Divine operation. In illustration of this, the following passages may be taken: "I am the Lord, your Holy One, the Creator of Israel, your King." "Thus saith the Lord, which maketh a way in the sea and a path in the mighty waters;" alluding, most probably, to the passage of Israel through the Red Sea, and, afterwards, to their crossing the Jordan, both of which events were unquestionably miraculous.

That one great object kept in view by the Redeemer in performing miracles was, to furnish convincing proofs of his Divine mission, is evident from the uniform tenor of the inspired narratives. Nicodemus reasoned justly when he said, "Rabbi, we know that thou art a teacher come from God: for no man can do these miracles that thou doest, except God be with him," John iii. 2. The same conviction was possessed by the chief priests and the Pharisees, for they said, after the resurrection of Lazarus, "This man doeth many miracles: if we let him thus alone all men will believe on him," John xi. 47, 48. Our Lord himself appeals to his miracles: "I have greater witness than that of John, for the works which the Father hath given me to finish, the same works that I do bear witness of me, that the Father hath sent me," John v. 36.

It is impossible, therefore, that any statement could be more plain and decisive. Our Lord rests his claim to be believed on the wonders he wrought. Again, he says, "If I had not done among them the works which none other man did, they had not had sin; but now they have no cloak for their sin." Thus, we see the wonders which Christ wrought were unparalleled. He healed the sick, he penetrated the minds of men by his own infinite power. And hence, the unbelief of those who witnessed his mighty deeds appeared in all its aggravated and naked enormity; "their sin remained." But, in direct opposition to this, there would have been a plea for unbelief had pretended miracles been true. Had it been a fact, instead of a fable, that Æsculapius had cured disease at his oracle, or that the god of the oracle of Claros had known the thoughts of men's hearts, then, and then only, there would have been a cover for their iniquity.

Were we to select one miracle as demonstrative that Jesus was sent by the Father, and of the acceptance of his work; and, still further, of the futility of every objection that can be raised against it; it should be that of the resurrection of the Lord Jesus Christ. "See," says Saurin, "how many extravagant suppositions must be advanced if the resurrection of our Saviour be denied. It must be supposed that guards, who had been particularly cautioned by their officers, sat down to sleep; and that, nevertheless, they deserved credit when the

body of Jesus was stolen. It must be supposed that men who had been imposed on in the most odious and cruel manner in the world, hazarded their dearest enjoyments for the glory of an impostor. It must be supposed that ignorant and illiterate men, who had neither reputation, fortune, nor eloquence, possessed the art of fascinating the eyes of all the church. It must be supposed either that five hundred persons were all deprived of their senses at a time, or that they were all deceived in the plainest matters of fact; or, that this multitude of false witnesses had found out the secret of never contradicting themselves or one another, and of being always uniform in their testimony. It must be supposed that the most expert courts of judicature could not find out a shadow of a contradiction in a palpable imposture. It must be supposed that the apostles, sensible men in other cases, chose precisely those places and those times which were most unfavourable to their views. It must be supposed that millions madly suffered imprisonments, tortures, and crucifixion, to spread an illusion. It must be supposed that ten thousand miracles were wrought in favour of falsehoods, or all these facts must be denied. And then, it must be supposed that the apostles were idiots, that the enemies of Christianity were idiots, and that all the primitive Christians were idiots."

The apostles of our Lord were invested with miraculous powers: "God also bearing them witness, both with signs and wonders, and with

divers miracles and gifts of the Holy Ghost, according to his own will," Heb. ii. 4. As the apostles asserted a direct and unequivocal claim to miraculous powers, and as these are declared in the New Testament to have been exerted by them, falsehood, if proved, would destroy the veracity of their writings, and the validity of all the doctrines and precepts they contained. But, let the case be duly weighed, and it will be seen, that, to support their pretensions by artifice and chicanery, was absolutely impossible. A few might be deceived, an empire could not be; and great must be the infatuation of supposing that a few obscure men could blind the eyes of the people among whom they lived. In the face of the utmost hostility, in the midst of the greatest perils, in defiance of cruel persecutions, and with the crucifixion of their Lord before their eyes, they could not have claimed the exercise of miraculous powers if they had not been actually possessed. Had they resembled the Romanists, to whom we have referred, would it have been possible to escape detection?

It is worthy of special remark, that more than one account is given us in sacred history of the messengers of God entering into collision with those who pretended to supernatural power. Thus a memorable contest took place between Moses and the magicians of Pharaoh's court. Different opinions are entertained as to the means by which the latter performed their feats, some contending that they were mere

tricks, and others that evil spirits were in active operation. On this controverted question we do not enter; it is sufficient for the present purpose to remark, that the superiority of the servants of Jehovah was placed beyond all dispute. The rod of Aaron swallowed up the rods of the magicians; at the plague of flies and the murrain on the cattle, they were compelled to say, "This is the finger of God;" and at length they "could not stand before Moses because of the boils, for the boils were upon the magicians and all the Egyptians," Exod. ix. 11.

Another instance of a later date is equally conclusive. The gospel was proclaimed at Ephesus, where the arts which pretended to lay open the secrets of nature, and to arm the hand of man with supernatural powers, were especially apparent. Indeed, in the age of our Lord and his apostles, pretended adepts in the occult sciences were numerous; they travelled from country to country, and were found in great numbers in Asia, deceiving the credulous multitude, and profiting by their expectations. They were sometimes Jews, who referred their skill, and even their forms of proceeding, to Solomon, who is still regarded in the east as the head or prince of magicians. In Asia Minor, Ephesus had a high reputation for magical arts. Here, then, "God wrought special miracles by the hands of Paul." The appeal to the wonder-workers of a country which contained so magnificent a temple to Diana, that it was reckoned among the wonders

of the world, was singularly striking. Accustomed as the Ephesians were to produce strange results by some species of magic, they would naturally ascribe miracles to a similar agency. It was necessary, therefore, that the miracles which were to serve as the credentials of Christianity, should be especially marked, and placed beyond the reach of all their enchantments and incantations. And it seems an instance not the less remarkable, because easily overlooked, of the adaptation of means to an end, that in Ephesus, in which, of all others, magic was resorted to, the powers granted to the first heralds of redeeming mercy sufficed to place them at an immeasurable distance above the most consummate magicians.

Another fact is equally entitled to attention. Certain Jews travelling in that country, and professing to cast out the evil spirits which frequently possessed the bodies of men, took upon them, as avowed exorcists, to employ the name of the Lord Jesus, from the success with which it was used by the apostle Paul. Amongst these were the seven sons of Sceva, a Jew, who addressed an evil spirit in the name of Christ, thinking, perhaps, that their number would give special force to their adjuration. The spirit, however, answered, "Jesus I know, and Paul I know, but who are ye?" nor was he content with refusing to be thus ejected; for, causing the man in whom he dwelt to put forth supernatural strength, "he leaped upon the young men and overcame them, and forced them to

flee out of the house naked and wounded." These facts soon became notorious; fear fell alike on the Jews and Greeks residing at Ephesus; the most potent appeal had been made to those accustomed to use charms and incantations; and numbers were led at once to renounce their arts of magic.

Very celebrated were the "Ephesian letters," which appear to have been a sort of magical formula written on paper or parchment, designed to be fixed as amulets on different parts of the body, such as the hands and the head. Erasmus says, that they were certain signs or marks which rendered their possessor victorious in everything. Eustatius mentions an opinion that Crœsus, when on his funeral pile, was very much benefited by the use of them; and that when a Milesian and an Ephesian were wrestling in the Olympic games, the former could gain no advantage, as the latter had Ephesian letters bound round his heel; but these being removed he lost his superiority, and was thrown thirty times. Many of these were, probably, among the books of which we read, Acts xix. 19; while others were most likely occupied by descriptions of the prevailing modes of practising "enchantments." But all were promptly and cheerfully consigned to the flames. Thus the sincerity of the converts was evident by no trifling sacrifice, for, when they counted the price of these books, they "found it fifty thousand pieces of silver. So mightily grew the word of God and prevailed."

That there was a difference between the operations of the apostles and the agency of our Lord, should be clearly perceived. The power of the Saviour was inherent—that of the apostles was derived. How manifest is the miraculous agency of Christ shown in the cure of the leper! "Lord, if thou wilt," said he to the Saviour, "thou canst make me clean." Jesus answered, "I will—be thou clean," and immediately he was made whole. Our Lord made no appeal to any other power. At the grave of Lazarus, indeed, he "lifted up his eyes, and said, Father, I thank thee that thou hast heard me." But this prayer appears to have been offered not on his own account, but for the sake of those who surrounded him, and who needed such a seal to his mission to establish their faith. Therefore, he added, "And I know that thou hearest me always: but because of the people which stand by I said it, that they may believe that thou hast sent me." And as on other occasions, he said, "Thy sins are forgiven thee"—"Arise, take up thy bed and walk"—"I command thee to come out of her," so now he cried with a loud voice, "Lazarus, come forth. And he that was dead came forth, bound hand and foot with grave-clothes: and his face was bound about with a napkin. Jesus saith unto them, Loose him, and let him go," John xi. 42—44.

Our Lord had previously said, "Therefore, doth my Father love me, because I lay down my life, that I might take it again. No man

taketh it from me, but I lay it down of myself. I have power to lay it down, and I have power to take it again. This commandment have I received of my Father," John x. 17, 18. In like manner, Jesus said to Martha, "I am the resurrection, and the life: he that believeth in me, though he were dead, yet shall he live: and whosoever liveth and believeth in me shall never die," John xi. 25, 26. How strikingly contrasted was the language of the apostles! In the case of the lame man laid at the beautiful gate of the temple, Peter said, "Silver and gold have I none; but such as I have give I thee: In the name of Jesus Christ of Nazareth, rise up and walk." These words, uttered on the first miracle of the apostles, expressed the great principle on which they performed every other, and the spirit in which they wrought all their wondrous deeds.

The apostle, like the prophet, laid down his authority, and resigned his commission with his life; but our Lord Jesus Christ not only exercised his power amidst his last sufferings and death, but extended his authority beyond the grave." "I lay down my life of myself; no man taketh it from me; I have power to lay it down, and I have power to take it again." And though he said, "This commandment have I received of my Father," he also added, "I and my Father are one"—"thereby," as the Jews distinctly perceived, "making himself equal with God."

Even the diversity of gifts distributed among

primitive saints, proved the infinite resources of Him by whom they were granted. Though bestowed by the Holy Spirit, they were purchased by the blood and supplied by the grace of the Son of God. Speaking of the outpouring of the Spirit, and its results, Jesus said, "He shall receive of mine, and shall show it unto you." Most emphatically does he lay claim to all the fulness of the Godhead, when he adds, "All things that the Father hath are mine: therefore said I, that he shall take of mine, and show it unto you." Thus, the gift of tongues, of miracles, of prophecy, and of interpretation, proved the infinite power of the Giver, on whose will the extent and diversity of the operation alike depended. Some had one power and some another: but all these wrought that one and the selfsame Spirit, dividing to every man severally as he would. 1 Cor. xii. 11.

The miraculous endowments of early times were, however, transient. Certain facts appear to be conclusive on this point. No gift was more highly estimated, or considered more necessary for the propagation of the gospel, than the gift of tongues. And yet, this was, unquestionably, of short duration. The only reference made to it in all the documents of antiquity, is in the work of Irenæus against the heretics. He says, "We hear of many in the church imbued with prophetic gifts, speaking with all kinds of tongues." But though he must have required the gift as much as any—for he was called to labour for the diffusion of

the gospel among the pagan Celts—yet he expressly declares, "It was not the least part of his trouble, that he was forced to learn the language of the country, a rude and barbarous dialect, before he could effect any good among them." Augustine, it is evident, knew nothing of supernatural power like that which some had possessed at a former period. "In the primitive times," he says, "the Holy Spirit fell upon believers, and they spoke in tongues which they had not learned, as the Spirit gave them utterance. These were signs suitable for the time. It was right that the Holy Spirit should thus be borne witness of in all tongues, throughout the world. That testimony being given, it passed away." With equal explicitness Chrysostom affirms, "Of miraculous powers not so much as a single vestige or trace remains."

In vain do Romanists contend for the continuance of miracles. Never have they been able to produce a solitary instance in which the gift of tongues has been exercised. And yet, if any member of their church might have been expected to be so endowed, it certainly would have been Francis Xavier, who has been called "the apostle of the Indies." But even he confesses that, ignorant of the language of the people to whom he went, he was incapable of doing any service to the Christian cause, and was little more than a mute statue among them, till he could acquire some competent knowledge of their tongues.

Miracles have passed away; but we still possess the glorious gospel of the blessed God. A power, however, more than human is needed to apply it to the heart. To open the blind eyes, to unstop the deaf ears, to give spiritual discernment to the mind, to break down prejudice, to humble pride, to "cast down imaginations and every high thing that exalteth itself against the knowledge of God," is the work of the Holy Spirit. Paul, as he cast around him "the good seed of the kingdom," might have given up all in despair, but for interposing Omnipotence. "I have planted," he said, "Apollos watered; but God gave the increase. So then neither is he that planteth anything, neither he that watereth; but God that giveth the increase."

There is, however, a great diversity in the operations of the same Divine Spirit. Some are brought at once "from the power of Satan unto God;" and ever will the time and circumstances of their conversion be held in remembrance. Others are led by a slow and gradual process—perhaps scarcely perceptible, and affording few points of prominent recollection, out of darkness into "marvellous light." Still the result is the same. All are brought to Jesus, and believe on him as having died for their sins, and risen again for their justification; all by virtue of union with him, under the sanctifying influence of the Holy Spirit, are become new creatures, enjoying the blessings of his great salvation, holding communion with him,

increasing in resemblance to him, and yielding to him practical obedience and devotion. To him, then, let us constantly look, to apply the truth to our own consciences and hearts, to sanctify us wholly, body, soul, and spirit, and to prosper every effort we make in behalf of others.

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